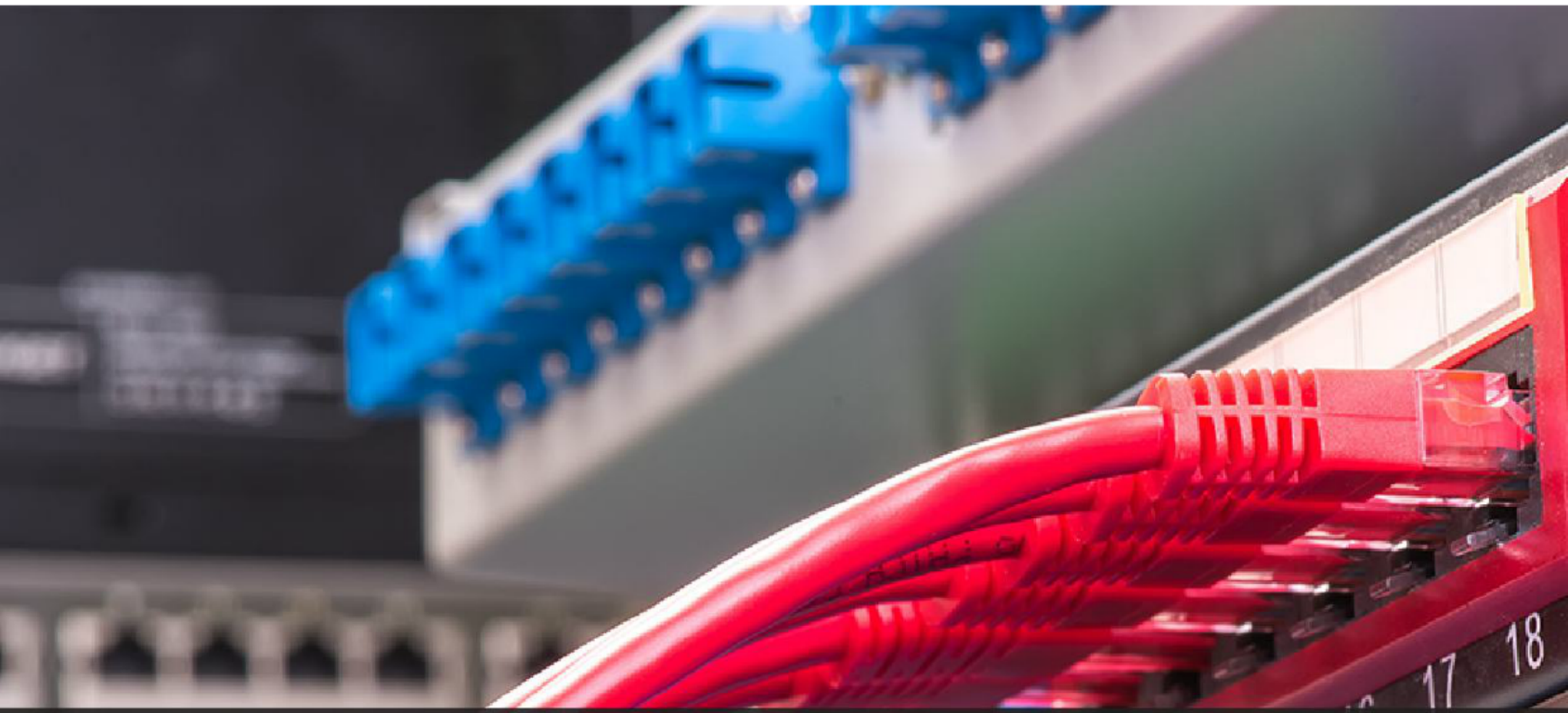
ZOOM
TECHNOLOGIES



CCNP | Cisco Certified Network Professional

Lab Manual

CCNP

(Cisco Certified Network Professional)

Certification Mapped Course

Route, Switch and Troubleshoot

Lab Manual

Introduction

This lab manual is designed as a supplement to the CCNP (Route and Switch) mapped course offered by Zoom Technologies.

All the three modules of the CCNP mapped course - Route, Switch and Troubleshoot have been bundled into a single, easy to use lab manual.

We have completely redesigned and revamped the lab exercises, and also included a number of new exercises to give the student a comprehensive guide to building scalable and robust multi layered networks. The exercises are arranged in order of complexity, beginning from the basic to the most advanced configuration.

We have adopted the same approach that we did in the CCNA mapped lab manual. The exercises are divided into five sections:

1. Objective
2. Topology
3. Tasks
4. Configuration steps
5. Verification

We have ensured that the verification section includes several different ways of confirming that the configuration was correctly done - including specific show commands, ping and trace route and sometimes using debug commands to look at various phases.

We hope that the students derive benefit from this lab manual. Any suggestions or feedback about the book would be greatly appreciated.

Table of Contents

ROUTE

SWITCH

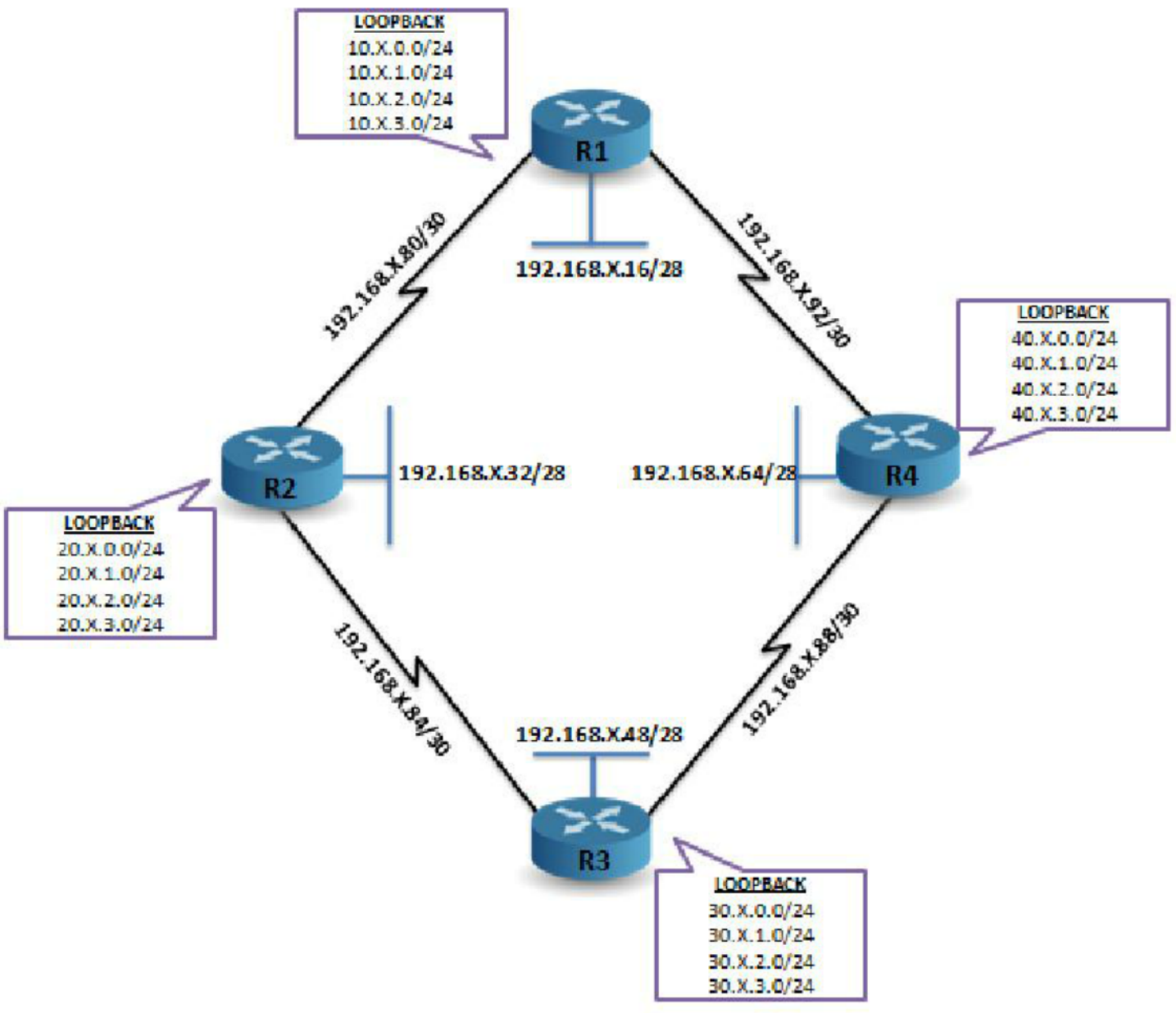
TROUBLESHOOT

LAB 1: CONFIGURING AND INVESTIGATING BASIC EIGRP

OBJECTIVE:

To establish connectivity between networks by configuring EIGRP on all routers

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring EIGRP on all the routers.
3) Configure EIGRP in all routers by using AS number 100
4) Verify Tables in EIGRP
5) Verify the connectivity using Ping command.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure EIGRP on all routers using AS number 100

   R1 (config)#router eigrp 100
   R1 (config-router)# network 10.0.0.0
   R1 (config-router)#network 192.168.X.0
   R2 (config)#router eigrp 100
   R2(config-router)#network 20.0.0.0
   R2(config-router)#network 192.168.X.0
   R3(config)#router eigrp 100
   R3(config-router)#network 192.168.X.0
   R4(Config)# router eigrp 100
   R4(config-router)#network 20.0.0.0
   R4(config-router)#network 192.168.X.0

VERIFICATION:

Check the EIGRP neighbor table, Topology table and Routing Table on all the routers.

➔ To check Neighbor Table use the following command in all routers

R1, R2, R3, R4#show ip eigrp neighbors

R1#show ip eigrp neighbors

EIGRP-IPv4 Neighbors for AS(100)

H	Address	Interface	Hold (sec)	Uptime	SRTT (ms)	RTO	Q Cnt	Seq Num
1	192.168.1.93	Se0/1/0	11	0:11:43	5	200	0	9
0	192.168.1.82	Se0/1/1	14	00:12:09	46	276	0	16

➔ To check Topology Table use following command in all routers

R1, R2, R3, R4#show ip eigrp topology
R1#show ip eigrp topology

EIGRP-IPv4 Topology Table for AS(100)/ID(10.1.3.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - reply Status, s - sia Status
P 20.1.1.0/24, 1 successors, FD is 2297856
via 192.168.1.82 (2297856/128256), Serial0/1/1
P 30.1.1.0/24, 2 successors, FD is 2809856
via 192.168.1.82 (2809856/2297856), Serial0/1/1
via 192.168.1.93 (2809856/2297856), Serial0/1/0
P 40.1.0.0/24, 1 successors, FD is 2297856

via 192.168.1.93 (2297856/128256), Serial0/1/0
P 192.168.1.48/28, 2 successors, FD is 2684416
via 192.168.1.82 (2684416/2172416), Serial0/1/1
via 192.168.1.93 (2684416/2172416), Serial0/1/0
P 30.1.0.0/24, 2 successors, FD is 2809856
via 192.168.1.82 (2809856/2297856), Serial0/1/1
via 192.168.1.93 (2809856/2297856), Serial0/1/0
P 10.1.3.0/24, 1 successors, FD is 128256
via Connected, Loopback3
P 10.1.0.0/24, 1 successors, FD is 128256
via Connected, Loopback0
P 20.1.0.0/24, 1 successors, FD is 2297856
via 192.168.1.82 (2297856/128256), Serial0/1/1
P 10.1.2.0/24, 1 successors, FD is 128256
via Connected, Loopback2
P 192.168.1.64/28, 1 successors, FD is 2172416
via 192.168.1.93 (2172416/28160), Serial0/1/0
P 192.168.1.16/28, 1 successors, FD is 28160
via Connected, FastEthernet0/0
P 192.168.1.84/30, 1 successors, FD is 2681856
via 192.168.1.82 (2681856/2169856), Serial0/1/1
P 192.168.1.32/28, 1 successors, FD is 2172416
via 192.168.1.82 (2172416/28160), Serial0/1/1
P 192.168.1.80/30, 1 successors, FD is 2169856
via Connected, Serial0/1/1
P 192.168.1.92/30, 1 successors, FD is 2169856
via Connected, Serial0/1/0
P 40.1.3.0/24, 1 successors, FD is 2297856
via 192.168.1.93 (2297856/128256), Serial0/1/0
P 40.1.1.0/24, 1 successors, FD is 2297856
via 192.168.1.93 (2297856/128256), Serial0/1/0
P 20.1.2.0/24, 1 successors, FD is 2297856
via 192.168.1.82 (2297856/128256), Serial0/1/1
P 40.1.2.0/24, 1 successors, FD is 2297856
via 192.168.1.93 (2297856/128256), Serial0/1/0
P 192.168.1.88/30, 1 successors, FD is 2681856
via 192.168.1.93 (2681856/2169856), Serial0/1/0
P 10.1.1.0/24, 1 successors, FD is 128256
via Connected, Loopback1
P 20.1.3.0/24, 1 successors, FD is 2297856
via 192.168.1.82 (2297856/128256), Serial0/1/1
P 30.1.3.0/24, 2 successors, FD is 2809856
via 192.168.1.82 (2809856/2297856), Serial0/1/1
via 192.168.1.93 (2809856/2297856), Serial0/1/0
P 30.1.2.0/24, 2 successors, FD is 2809856
via 192.168.1.82 (2809856/2297856), Serial0/1/1
via 192.168.1.93 (2809856/2297856), Serial0/1/0

➔ To check Routing Table use following command in all routers

R1, R2, R3, R4#show ip route

R1#show ip route

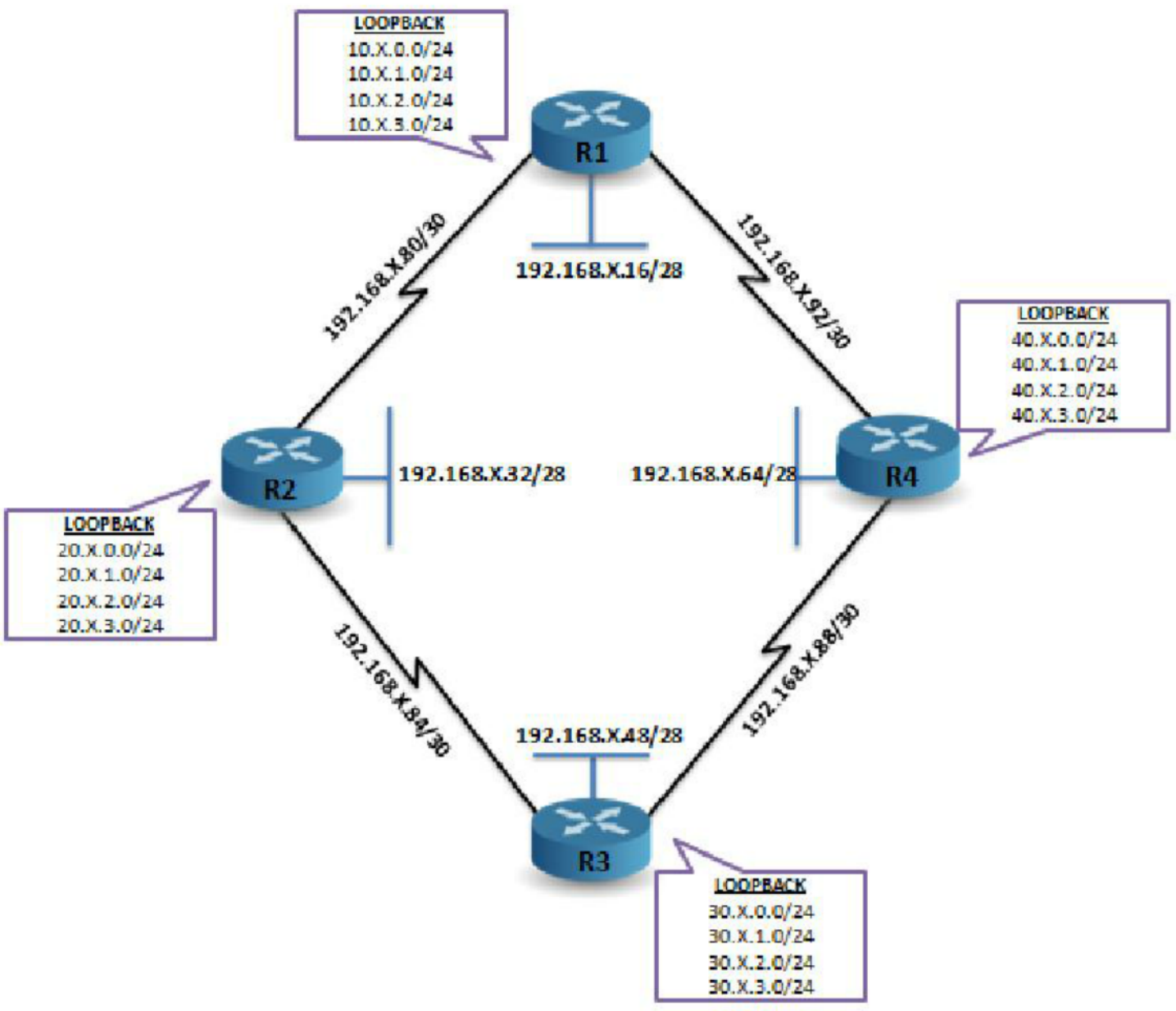
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B – BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l – LISP
+ - replicated route, % - next hop override
Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       10.1.0.0/24 is directly connected, Loopback0
L       10.1.0.1/32 is directly connected, Loopback0
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     20.0.0.0/24 is subnetted, 4 subnets
D       20.1.0.0 [90/2297856] via 192.168.1.82, 00:18:22, Serial0/1/1
D       20.1.1.0 [90/2297856] via 192.168.1.82, 00:18:22, Serial0/1/1
D       20.1.2.0 [90/2297856] via 192.168.1.82, 00:18:22, Serial0/1/1
D       20.1.3.0 [90/2297856] via 192.168.1.82, 00:18:22, Serial0/1/1
     30.0.0.0/24 is subnetted, 4 subnets
D       30.1.0.0 [90/2809856] via 192.168.1.93, 00:18:00, Serial0/1/0
  [90/2809856] via 192.168.1.82, 00:18:00, Serial0/1/1
D       30.1.1.0 [90/2809856] via 192.168.1.93, 00:18:00, Serial0/1/0
  [90/2809856] via 192.168.1.82, 00:18:00, Serial0/1/1
D       30.1.2.0 [90/2809856] via 192.168.1.93, 00:18:00, Serial0/1/0
  [90/2809856] via 192.168.1.82, 00:18:00, Serial0/1/1
D       30.1.3.0 [90/2809856] via 192.168.1.93, 00:18:00, Serial0/1/0
  [90/2809856] via 192.168.1.82, 00:18:00, Serial0/1/1
     40.0.0.0/24 is subnetted, 4 subnets
D       40.1.0.0 [90/2297856] via 192.168.1.93, 00:17:56, Serial0/1/0
D       40.1.1.0 [90/2297856] via 192.168.1.93, 00:17:56, Serial0/1/0
D       40.1.2.0 [90/2297856] via 192.168.1.93, 00:17:56, Serial0/1/0
D       40.1.3.0 [90/2297856] via 192.168.1.93, 00:17:56, Serial0/1/0
     192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
D       192.168.1.32/28 [90/2172416] via 192.168.1.82, 00:18:25, Serial0/1/1
D       192.168.1.48/28 [90/2684416] via 192.168.1.93, 00:18:00, Serial0/1/0
  [90/2684416] via 192.168.1.82, 00:18:00, Serial0/1/1
D       192.168.1.64/28 [90/2172416] via 192.168.1.93, 00:00:19, Serial0/1/0
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
D       192.168.1.84/30 [90/2681856] via 192.168.1.82, 00:18:00, Serial0/1/1
D       192.168.1.88/30 [90/2681856] via 192.168.1.93, 00:18:00, Serial0/1/0
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

LAB 2: EIGRP SUMMARIZATION

OBJECTIVE:

To configure summarization on all routers so that 4 loopback addresses are represented by a single EIGRP entry in routing table.

TOPOLOGY:



Pre-requisite:Basic EIGRP configuration to be done on all routers (LAB – 1)

TASKS:

1) Verify the interface status in all the routers
2) Check the routing table before configuring EIGRP on all the routers.
3) Configure EIGRP on all routers by using AS number 100
4) Configure Manual Summarization on a per interface basis
5) Verify the output

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers before configuring the EIGRP on all the routers by using the command.

   Router#show ip route

3) Configure EIGRP with AS 100 on all the routers as did in previous lab.

4) Disable Auto Summarization in all the routers before configuring Manual Summarization.

   Router(config)# router eigrp 100

   Router(config-router)# no auto-summary

5) Configure Manual Summarization.This is configured on the interfaces which are connected to EIGRP neighbors. To know the interfaces which are connected to EIGRP neighbors execute the following command :

   R1#show ip eigrp neighbors

   EIGRP-IPv4 Neighbors for AS(100)

H	Address	Interface	Hold (sec)	Uptime	SRTT (ms)	RTO	Q Cnt	Seq Num
1	192.168.1.93	Se0/1/0	11	0 0:11:43	5	200	0	9
0	192.168.1.82	Se0/1/1	14	00:12:09	46	276	0	16

6) Configure Manual summarization on the interfaces shown as a result of the above command.

   Use **ip summary-address eigrp** command.

   R1 (config)#interface serial 0/1/0
   R1 (config-if)# ip summary-address eigrp 100 10.X.0.0 255.255.252.0
   R1 (config)#interface serial 0/1/1
   R1 (config-if)# ip summary-address eigrp 100 10.X.0.0 255.255.252.0

7) Repeat these steps on all theother routers to configure Manual summarization.

VERIFICATION:

After summarization, thelocal router will showa NULL0 interface and summary address will be available in all the neighbor routers.

R1#show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

```
      + - replicated route, % - next hop override
Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 9 subnets, 3 masks
D       10.1.0.0/22 is a summary, 00:00:16, Null0
C       10.1.0.0/24 is directly connected, Loopback0
L       10.1.0.1/32 is directly connected, Loopback0
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     20.0.0.0/24 is subnetted, 4 subnets
D       20.1.0.0 [90/2297856] via 192.168.1.82, 00:28:02, Serial0/1/1
D       20.1.1.0 [90/2297856] via 192.168.1.82, 00:28:02, Serial0/1/1
D       20.1.2.0 [90/2297856] via 192.168.1.82, 00:28:02, Serial0/1/1
D       20.1.3.0 [90/2297856] via 192.168.1.82, 00:28:02, Serial0/1/1
     30.0.0.0/24 is subnetted, 4 subnets
D       30.1.0.0 [90/2809856] via 192.168.1.93, 00:27:40, Serial0/1/0
                 [90/2809856] via 192.168.1.82, 00:27:40, Serial0/1/1
D       30.1.1.0 [90/2809856] via 192.168.1.93, 00:27:40, Serial0/1/0
                 [90/2809856] via 192.168.1.82, 00:27:40, Serial0/1/1
D       30.1.2.0 [90/2809856] via 192.168.1.93, 00:27:40, Serial0/1/0
                 [90/2809856] via 192.168.1.82, 00:27:40, Serial0/1/1
D       30.1.3.0 [90/2809856] via 192.168.1.93, 00:27:40, Serial0/1/0
                 [90/2809856] via 192.168.1.82, 00:27:40, Serial0/1/1
     40.0.0.0/24 is subnetted, 4 subnets
D       40.1.0.0 [90/2297856] via 192.168.1.93, 00:27:36, Serial0/1/0
D       40.1.1.0 [90/2297856] via 192.168.1.93, 00:27:36, Serial0/1/0
D       40.1.2.0 [90/2297856] via 192.168.1.93, 00:27:36, Serial0/1/0
D       40.1.3.0 [90/2297856] via 192.168.1.93, 00:27:36, Serial0/1/0
     192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
D       192.168.1.32/28 [90/2172416] via 192.168.1.82, 00:28:05, Serial0/1/1
D       192.168.1.48/28 [90/2684416] via 192.168.1.93, 00:27:40, Serial0/1/0
                        [90/2684416] via 192.168.1.82, 00:27:40, Serial0/1/1
D       192.168.1.64/28 [90/2172416] via 192.168.1.93, 00:09:59, Serial0/1/0
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
D       192.168.1.84/30 [90/2681856] via 192.168.1.82, 00:27:40, Serial0/1/1
D       192.168.1.88/30 [90/2681856] via 192.168.1.93, 00:27:40, Serial0/1/0
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

R2#show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
```

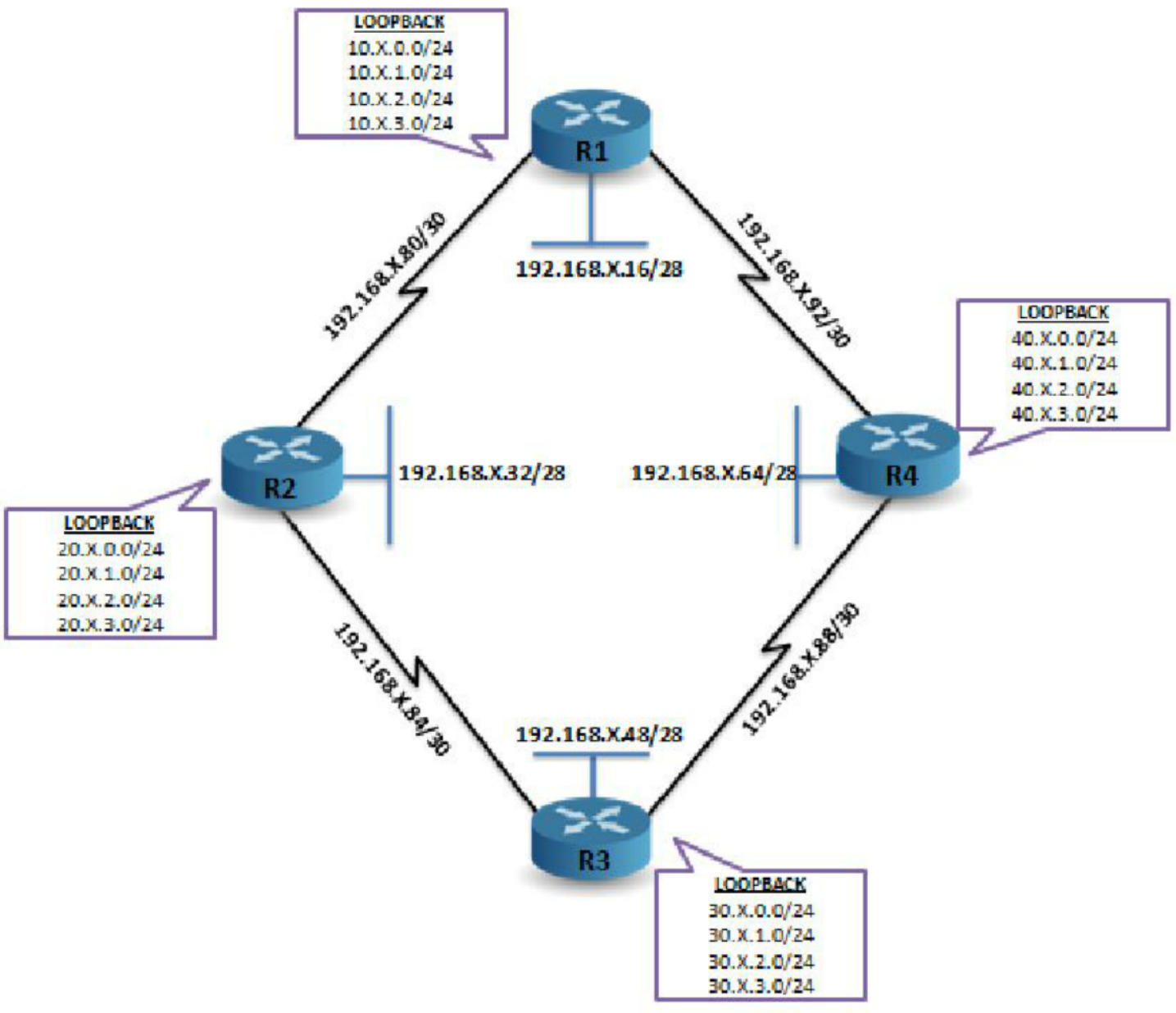
```
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
     10.0.0.0/22 is subnetted, 1 subnets
D       10.1.0.0 [90/2297856] via 192.168.1.81, 00:02:15, Serial0/0/1
     20.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.2.0/24 is directly connected, Loopback2
L       20.1.2.1/32 is directly connected, Loopback2
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     30.0.0.0/24 is subnetted, 4 subnets
D       30.1.0.0 [90/2297856] via 192.168.1.86, 00:30:14, Serial0/0/0
D       30.1.1.0 [90/2297856] via 192.168.1.86, 00:30:14, Serial0/0/0
D       30.1.2.0 [90/2297856] via 192.168.1.86, 00:30:14, Serial0/0/0
D       30.1.3.0 [90/2297856] via 192.168.1.86, 00:30:14, Serial0/0/0
     40.0.0.0/24 is subnetted, 4 subnets
D       40.1.0.0 [90/2809856] via 192.168.1.86, 00:29:44, Serial0/0/0
  [90/2809856] via 192.168.1.81, 00:29:44, Serial0/0/1
D       40.1.1.0 [90/2809856] via 192.168.1.86, 00:29:44, Serial0/0/0
  [90/2809856] via 192.168.1.81, 00:29:44, Serial0/0/1
D       40.1.2.0 [90/2809856] via 192.168.1.86, 00:29:44, Serial0/0/0
  [90/2809856] via 192.168.1.81, 00:29:44, Serial0/0/1
D       40.1.3.0 [90/2809856] via 192.168.1.86, 00:29:44, Serial0/0/0
  [90/2809856] via 192.168.1.81, 00:29:44, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
D       192.168.1.16/28 [90/2172416] via 192.168.1.81, 00:30:14, Serial0/0/1
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
D       192.168.1.48/28 [90/2172416] via 192.168.1.86, 00:30:14, Serial0/0/0
D       192.168.1.64/28 [90/2684416] via 192.168.1.86, 00:12:07, Serial0/0/0
[90/2684416] via 192.168.1.81, 00:12:07, Serial0/0/1
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
D       192.168.1.88/30 [90/2681856] via 192.168.1.86, 00:29:48, Serial0/0/0
D       192.168.1.92/30 [90/2681856] via 192.168.1.81, 00:29:48, Serial0/0/1
```

LAB 3: EIGRP AUTHENTICATION

OBJECTIVE:

To configure EIGRP authentication between R1 and R2 routers

TOPOLOGY:



TASK:

1) Verify the interface status on all the routers
2) Check the routing table before configuring EIGRP on all the routers.
3) Configure EIGRP in all routers by using AS number 100
4) Verify Tables in EIGRP
5) Configure authentication between R1 router and R2 router. The key-chain name should be "zoom" and password should be "ccnp".

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers before configuring EIGRP on all the routers by using the command.

   Router#show ip route

3) Configure EIGRP with AS 100 on all the routers as done in previous lab.

4) Configure Key Chain on the routers where you want to implement authentication.

   R1(config)# key chain zoom
   R1(config-keychain)#key 1
   R1(config-keychain-key)#key-string ccnp
   R1(config-keychain-key)#exit
   R2(config)# key chain zoom
   R2(config-keychain)#key 1
   R2(config-keychain-key)#key-string ccnp
   R2(config-keychain-key)#exit

5) Implement authentication on the serial interfaces between R1 and R2

   R1#show cdp neighbours

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R2	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	173	R S I	2811	Ser 0/0/0

R1(config)#interface serial 0/1/1
R1(config-if)#ip authentication mode eigrp 100 md5
R1(config-if)#ip authentication key-chain eigrp 100 zoom

R2#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R3	Ser 0/0/0	169	R S I	2811	Ser 0/0/1
R1	Ser 0/0/1	174	R S I	2811	Ser 0/1/1

R2(config)#interface serial 0/0/1
R2(config-if)#ip authentication mode eigrp 100 md5
R2(config-if)#ip authentication key-chain eigrp 100 zoom

VERIFICATION:

R1#show keychain

```
Key-chain zoom:
key 1 -- text "ccnp"
        accept lifetime (always valid) - (always valid) [valid now]
        send lifetime (always valid) - (always valid) [valid now]
```

R2#show keychain

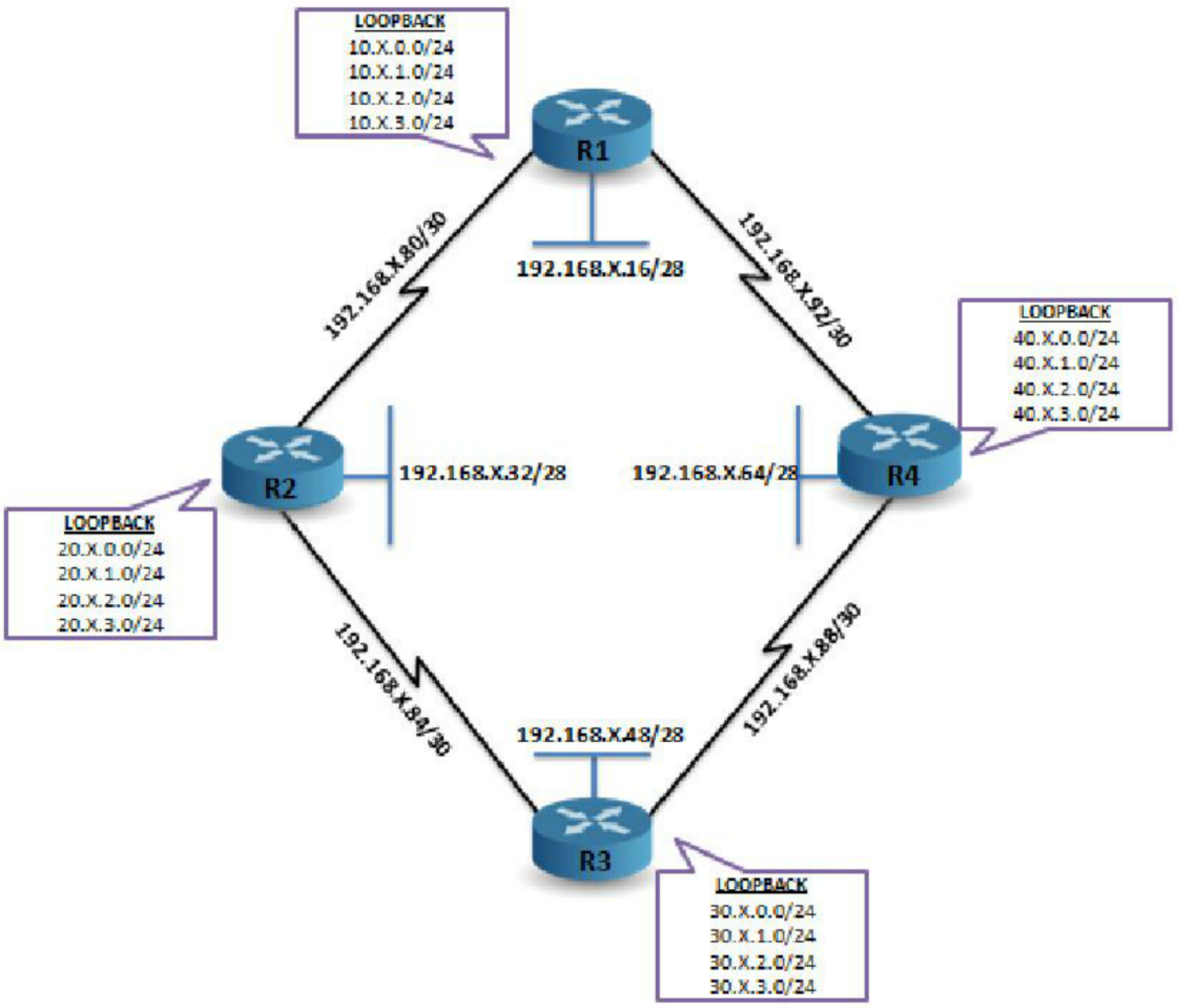
```
Key-chain zoom:
key 1 -- text "ccnp"
        accept lifetime (always valid) - (always valid) [valid now]
        send lifetime (always valid) - (always valid) [valid now]
```

LAB 4: LOAD BALANCING IN EIGRP

OBJECTIVE:

To configure EIGRP Load Balancing forreaching all the 10.0.0.0/24 networks from R3 router.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring EIGRP on all the routers.
3) Configure EIGRP in all routers by using AS number 100
4) Verify Tables in EIGRP
5) Verify Load Balancing in EIGRP

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers before configuring the EIGRP on all the routers by using the command.

   Router# show ip route

3) Configure EIGRP with AS 100 on all the routers as done in previous lab.

4) Configure Bandwidth on serial interfaces of all the routers.

   R1(config)# interface serial 0/1/0
   R1(config-if)# bandwidth 128
   R1(config)# interface serial 0/1/1
   R1(config-if)# bandwidth 128
   R2(config)# interface serial 0/0/1
   R2 (config-if)# bandwidth 128
   R2(config)# interface serial 0/0/0
   R2 (config-if)# bandwidth 64
   R3(config)# interface serial 0/0/1
   R3 (config-if)# bandwidth 64
   R3(config)# interface serial 0//0/0
   R3 (config-if)# bandwidth 128
   R4(config)# interface serial 0/0/1
   R4 (config-if)# bandwidth 128
   R4(config)# interface serial 0/0/0
   R4 (config-if)# bandwidth 128

Note: Names of the serial interface may vary, use show cdp neighbours to find serial interfaces of the router.

5) You will find successor and Feasible successor in the topology table of the R3 router but only the successor routes in the routing table.

6) Before configuring variance

   R3# show ip eigrp topology

   EIGRP-IPv4 Topology Table for AS(100)/ID(30.1.3.1)
   Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
   r - reply Status, s - sia Status
   P 20.1.1.0/24, 1 successors, FD is 21664000
   via 192.168.1.90 (21664000/21152000), Serial0/0/0
   via 192.168.1.85 (40640000/128256), Serial0/0/1
   P 30.1.1.0/24, 1 successors, FD is 128256 via Connected, Loopback1
   P 40.1.0.0/24, 1 successors, FD is 2297856 via 192.168.1.90 (20640000/128256), Serial0/0/0
   P 192.168.1.48/28, 1 successors, FD is 28160 via Connected, FastEthernet0/0
   P 30.1.0.0/24, 1 successors, FD is 128256 via Connected, Loopback0
   P 10.1.3.0/24, 1 successors, FD is 21152000 via 192.168.1.90 (21152000/20640000), Serial0/0/0

via 192.168.1.85 (41152000/20640000), Serial0/0/1
P 10.1.0.0/24, 1 successors, FD is 21152000 via 192.168.1.90 (21152000/20640000), Serial0/0/0
via 192.168.1.85 (41152000/20640000), Serial0/0/1
P 10.1.2.0/24, 1 successors, FD is 21152000 via 192.168.1.90 (21152000/20640000), Serial0/0/0
via 192.168.1.85 (41152000/20640000), Serial0/0/1
P 192.168.1.64/28, 1 successors, FD is 2172416 via 192.168.1.90 (20514560/28160), Serial0/0/0
P 192.168.1.16/28, 1 successors, FD is 21026560 via 192.168.1.90 (21026560/20514560), Serial0/0/0 via 192.168.1.85 (41026560/20514560), Serial0/0/1
P 192.168.1.84/30, 1 successors, FD is 40512000 via Connected, Serial0/0/1
P 192.168.1.32/28, 1 successors, FD is 21538560 via 192.168.1.90 (21538560/21026560), Serial0/0/0 via 192.168.1.85 (40514560/28160), Serial0/0/1
P 192.168.1.80/30, 1 successors, FD is 21536000 via 192.168.1.90 (21536000/21024000), Serial0/0/0 via 192.168.1.85 (41024000/20512000), Serial0/0/1
P 192.168.1.92/30, 1 successors, FD is 21024000 via 192.168.1.90 (21024000/20512000), Serial0/0/0, serno 133
P 40.1.3.0/24, 1 successors, FD is 2297856 via 192.168.1.90 (20640000/128256), Serial0/0/0
P 40.1.1.0/24, 1 successors, FD is 2297856 via 192.168.1.90 (20640000/128256), Serial0/0/0
P 20.1.2.0/24, 1 successors, FD is 21664000 via 192.168.1.90 (21664000/21152000), Serial0/0/0 via 192.168.1.85 (40640000/128256), Serial0/0/1
P 40.1.2.0/24, 1 successors, FD is 2297856 via 192.168.1.90 (20640000/128256), Serial0/0/0
P 192.168.1.88/30, 1 successors, FD is 20512000 via Connected, Serial0/0/0
P 10.1.1.0/24, 1 successors, FD is 21152000 via 192.168.1.90 (21152000/20640000), Serial0/0/0 via 192.168.1.85 (41152000/20640000), Serial0/0/1
P 20.1.3.0/24, 1 successors, FD is 21664000 via 192.168.1.90 (21664000/21152000), Serial0/0/0 via 192.168.1.85 (40640000/128256), Serial0/0/1
P 30.1.3.0/24, 1 successors, FD is 128256 via Connected, Loopback3
P 30.1.2.0/24, 1 successors, FD is 128256 via Connected, Loopback2

R3#show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
10.0.0.0/24 is subnetted, 4 subnets

D 10.1.0.0 [90/21152000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 10.1.1.0 [90/21152000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 10.1.2.0 [90/21152000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 10.1.3.0 [90/21152000] via 192.168.1.90, 00:01:56, Serial0/0/0

20.0.0.0/24 is subnetted, 4 subnets
D 20.1.0.0 [90/21664000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 20.1.1.0 [90/21664000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 20.1.2.0 [90/21664000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 20.1.3.0 [90/21664000] via 192.168.1.90, 00:01:56, Serial0/0/0
30.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

```
C       30.1.0.0/24 is directly connected, Loopback0
L       30.1.0.1/32 is directly connected, Loopback0
C       30.1.1.0/24 is directly connected, Loopback1
L       30.1.1.1/32 is directly connected, Loopback1
C       30.1.2.0/24 is directly connected, Loopback2
L       30.1.2.1/32 is directly connected, Loopback2
C       30.1.3.0/24 is directly connected, Loopback3
L       30.1.3.1/32 is directly connected, Loopback3
    40.0.0.0/24 is subnetted, 4 subnets
D       40.1.0.0 [90/20640000] via 192.168.1.90, 00:04:04, Serial0/0/0
D       40.1.1.0 [90/20640000] via 192.168.1.90, 00:04:04, Serial0/0/0
D       40.1.2.0 [90/20640000] via 192.168.1.90, 00:04:04, Serial0/0/0
D       40.1.3.0 [90/20640000] via 192.168.1.90, 00:04:04, Serial0/0/0
    192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
D       192.168.1.16/28 [90/21026560] via 192.168.1.90, 00:01:56, Serial0/0/0
D       192.168.1.32/28 [90/21538560] via 192.168.1.90, 00:01:56, Serial0/0/0
C       192.168.1.48/28 is directly connected, FastEthernet0/0
L       192.168.1.49/32 is directly connected, FastEthernet0/0
D       192.168.1.64/28 [90/20514560] via 192.168.1.90, 00:04:04, Serial0/0/0
D       192.168.1.80/30 [90/21536000] via 192.168.1.90, 00:01:56, Serial0/0/0
C       192.168.1.84/30 is directly connected, Serial0/0/1
L       192.168.1.86/32 is directly connected, Serial0/0/1
C       192.168.1.88/30 is directly connected, Serial0/0/0
L       192.168.1.89/32 is directly connected, Serial0/0/0
D       192.168.1.92/30 [90/21024000] via 192.168.1.90, 00:02:06, Serial0/0/0
```

7) To use feasible successors also in the routing table use variance command.

R3(config)# router eigrp 100
R3(config-router)# variance 2

VERIFICATION:

➔ **After Configuring Variance**

R3#show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
    10.0.0.0/24 is subnetted, 4 subnets
D       10.1.0.0 [90/21152000] via 192.168.1.90, 00:00:03, Serial0/0/0
                 [90/41152000] via 192.168.1.85, 00:00:03, Serial0/0/1
D       10.1.1.0 [90/21152000] via 192.168.1.90, 00:00:03, Serial0/0/0
                 [90/41152000] via 192.168.1.85, 00:00:03, Serial0/0/1
D       10.1.2.0 [90/21152000] via 192.168.1.90, 00:00:03, Serial0/0/0
                 [90/41152000] via 192.168.1.85, 00:00:03, Serial0/0/1
```

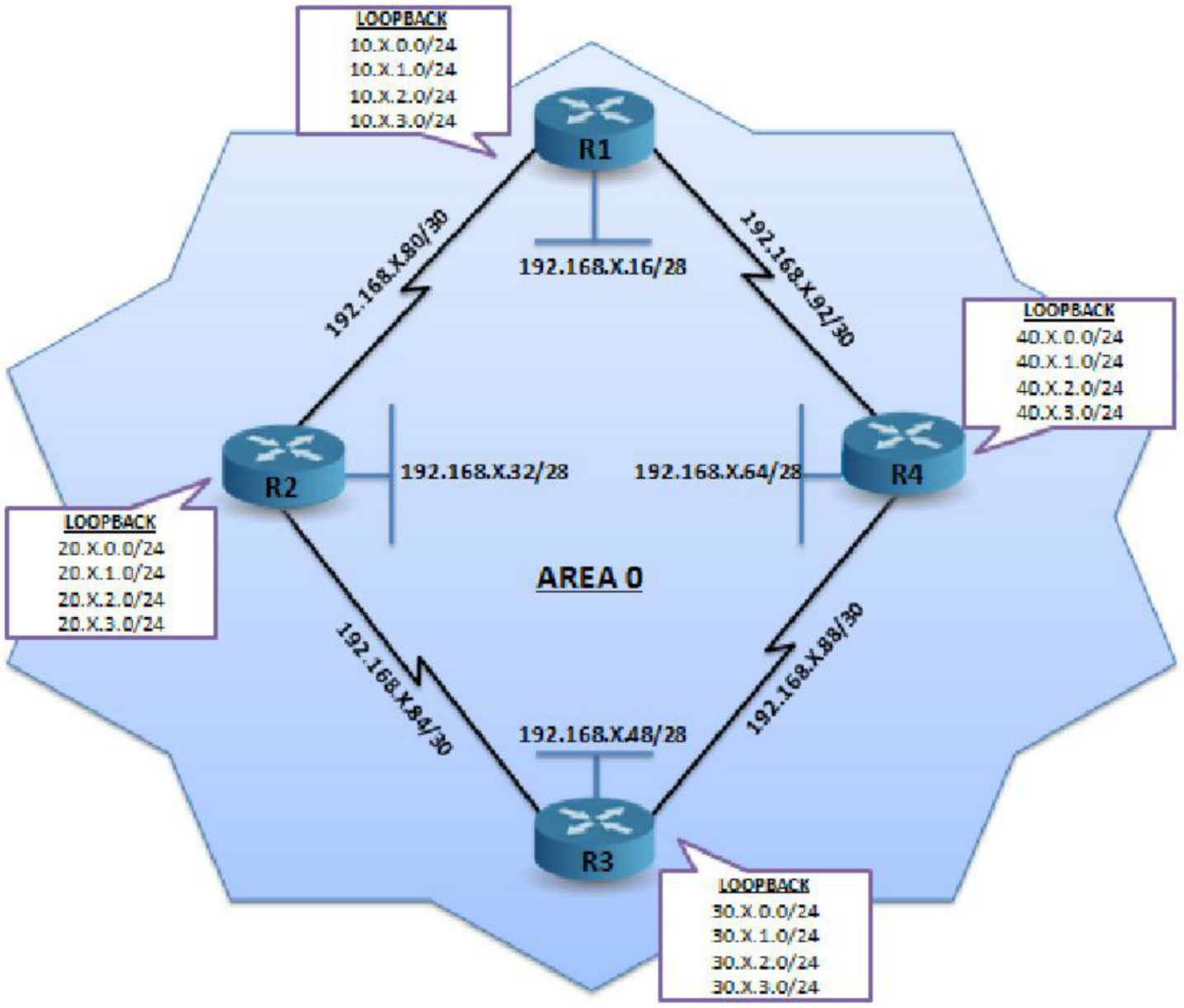
```
D       10.1.3.0 [90/21152000] via 192.168.1.90, 00:00:03, Serial0/0/0
                 [90/41152000] via 192.168.1.85, 00:00:03, Serial0/0/1
      20.0.0.0/24 is subnetted, 4 subnets
D        20.1.0.0 [90/21664000] via 192.168.1.90, 00:00:03, Serial0/0/0
                  [90/40640000] via 192.168.1.85, 00:00:03, Serial0/0/1
D        20.1.1.0 [90/21664000] via 192.168.1.90, 00:00:03, Serial0/0/0
                  [90/40640000] via 192.168.1.85, 00:00:03, Serial0/0/1
D        20.1.2.0 [90/21664000] via 192.168.1.90, 00:00:03, Serial0/0/0
                  [90/40640000] via 192.168.1.85, 00:00:03, Serial0/0/1
D        20.1.3.0 [90/21664000] via 192.168.1.90, 00:00:03, Serial0/0/0
                  [90/40640000] via 192.168.1.85, 00:00:03, Serial0/0/1
      30.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        30.1.0.0/24 is directly connected, Loopback0
L        30.1.0.1/32 is directly connected, Loopback0
C        30.1.1.0/24 is directly connected, Loopback1
L        30.1.1.1/32 is directly connected, Loopback1
C        30.1.2.0/24 is directly connected, Loopback2
L        30.1.2.1/32 is directly connected, Loopback2
C        30.1.3.0/24 is directly connected, Loopback3
L        30.1.3.1/32 is directly connected, Loopback3
      40.0.0.0/24 is subnetted, 4 subnets
D        40.1.0.0 [90/20640000] via 192.168.1.90, 00:00:03, Serial0/0/0
D        40.1.1.0 [90/20640000] via 192.168.1.90, 00:00:03, Serial0/0/0
D        40.1.2.0 [90/20640000] via 192.168.1.90, 00:00:03, Serial0/0/0
D        40.1.3.0 [90/20640000] via 192.168.1.90, 00:00:03, Serial0/0/0
      192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
D        192.168.1.16/28 [90/21026560] via 192.168.1.90, 00:00:03, Serial0/0/0
                         [90/41026560] via 192.168.1.85, 00:00:03, Serial0/0/1
D        192.168.1.32/28 [90/21538560] via 192.168.1.90, 00:00:03, Serial0/0/0
                         [90/40514560] via 192.168.1.85, 00:00:03, Serial0/0/1
C        192.168.1.48/28 is directly connected, FastEthernet0/0
L        192.168.1.49/32 is directly connected, FastEthernet0/0
D        192.168.1.64/28 [90/20514560] via 192.168.1.90, 00:00:03, Serial0/0/0
D        192.168.1.80/30 [90/21536000] via 192.168.1.90, 00:00:03, Serial0/0/0
                         [90/41024000] via 192.168.1.85, 00:00:03, Serial0/0/1
C        192.168.1.84/30 is directly connected, Serial0/0/1
L        192.168.1.86/32 is directly connected, Serial0/0/1
C        192.168.1.88/30 is directly connected, Serial0/0/0
L        192.168.1.89/32 is directly connected, Serial0/0/0
D        192.168.1.92/30 [90/21024000] via 192.168.1.90, 00:00:03, Serial0/0/0
```

LAB 5: BASIC OSPF

OBJECTIVE:

To establish connectivity between networks by configuring single area(area 0) OSPF on all routers.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure OSPF in all routers on AREA 0.
4) Verify Tables in OSPF
5) Verify the connectivity using Ping command.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF in all the routers

R1 (config)#router ospf 100
R1 (config-router)# network 10.X.0.0 0.0.255.255 area 0
R1 (config-router)# network 192.168.X.16 0.0.0.15 area 0
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
R1 (config-router)# network 192.168.X.92 0.0.0.3 area 0
R2 (config)#router ospf 100
R2 (config-router)#network 20.X.0.0 0.0.255.255 area 0
R2 (config-router) #network 192.168.X.32 0.0.0.15 area 0
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0
R3(config)#router ospf 100
R3(config-router)# network 30.X.0.0 0.0.255.255 area 0
R3(config-router)#network 192.168.X.48 0.0.0.15 area 0
R3(config-router) #network 192.168.X.84 0.0.0.3 area 0
R3(config-router) #network 192.168.X.88 0.0.0.3 area 0
R4(Config)# router ospf 100
R4(Config-router)# network 40.X.0.0 0.0.255.255 area 0
R4(Config-router)# network 192.168.X.64 0.0.0.15 area 0
R4 (Config-router)# network 192.168.X.88 0.0.0.3 area 0
R4(Config-router)# network 192.168.X.92 0.0.0.3 area 0

VERIFICATION:

➔ **Check the OSPF neighbor table, Database table and Routing Table on all the routers.**

To check Neighbor Table use following command in all routers

R1, R2, R3, R4#show ip ospf neighbor
R1#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
20.1.3.1	0	FULL/ -	00:00:35	192.168.1.82	Serial0/1/1
40.1.3.1	0	FULL/ -	00:00:31	192.168.1.93	Serial0/1/0

To check Database Table use following command in all routers
R1, R2, R3, R4#show ip ospf database
R1# show ip ospf database

OSPF Router with ID (10.1.3.1) (Process ID 1)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	136	0x80000002	0x002B5C	8
20.1.3.1	20.1.3.1	150	0x80000003	0x0087C2	8
30.1.3.1	30.1.3.1	138	0x80000002	0x0073D4	6

40.1.3.1 40.1.3.1 132 0x80000002 0x005D2C 9

To check Routing Table use following command in all routers

R1, R2, R3, R4#show ip route

R1#show ip route

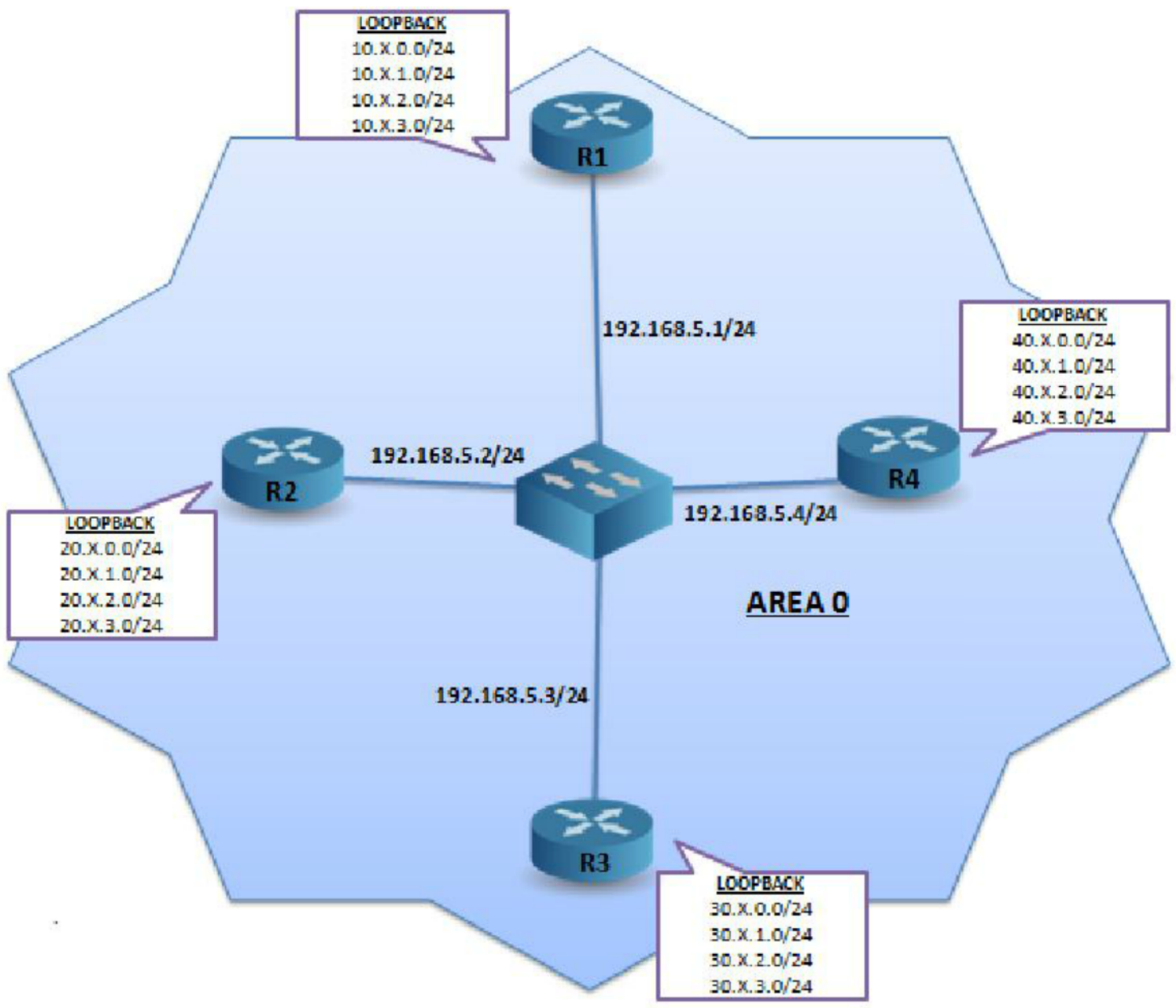
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B – BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l – LISP
       + - replicated route, % - next hop override
     10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     20.0.0.0/32 is subnetted, 3 subnets
O       20.1.0.1 [110/782] via 192.168.1.82, 00:03:12, Serial0/1/1
O       20.1.1.1 [110/782] via 192.168.1.82, 00:03:12, Serial0/1/1
O       20.1.3.1 [110/782] via 192.168.1.82, 00:03:12, Serial0/1/1
     30.0.0.0/32 is subnetted, 1 subnets
O       30.1.3.1 [110/1563] via 192.168.1.93, 00:02:58, Serial0/1/0
40.0.0.0/32 is subnetted, 4 subnets
O       40.1.0.1 [110/782] via 192.168.1.93, 00:02:58, Serial0/1/0
O       40.1.1.1 [110/782] via 192.168.1.93, 00:02:58, Serial0/1/0
O       40.1.2.1 [110/782] via 192.168.1.93, 00:02:58, Serial0/1/0
O       40.1.3.1 [110/782] via 192.168.1.93, 00:02:58, Serial0/1/0
     192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
O       192.168.1.32/28 [110/782] via 192.168.1.82, 00:03:12, Serial0/1/1
O       192.168.1.48/28 [110/1563] via 192.168.1.93, 00:02:58, Serial0/1/0
O       192.168.1.64/28 [110/782] via 192.168.1.93, 00:02:48, Serial0/1/0
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
O       192.168.1.84/30 [110/2343] via 192.168.1.82, 00:03:12, Serial0/1/1
O       192.168.1.88/30 [110/1562] via 192.168.1.93, 00:02:58, Serial0/1/0
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

LAB 6: OSPF DR/BDR election

OBJECTIVE:

To connect multiple OSPF routers in a broadcast multi-access network&To observe and control the OSPF DR/BDR election process.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure OSPF in all routers by using AREA 0.
4) Verify Tables in OSPF
5) Make Sure that R1 becomes DR router and R2 becomes BDR router by changing the prority.

STEPS:

1. Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers and advertise only 192.168.5.0 network

   R1 (config)#router ospf 100
   R1 (config-router)# network 192.168.5.0 0.0.0.255 area 0
   R2 (config)#router ospf 100
   R2 (config-router)#network 192.168.5.0 0.0.0.255 area 0
   R3(config)#router ospf 100
   R3(config-router)# network 192.168.5.0 0.0.0.255 area 0
   R4(Config)# router ospf 100
   R4(Config-router)# network 192.168.5.0 0.0.0.255 area 0

4) Verify which router becomes a DR and BDR by executing the following command on all routers

   Router# show ip ospf neighbor

5) Assign Priority to the routers in such a way that R1 router becomes DR and R2 router becomes BDR

   R1(config)# interface fastethernet 0/0
   R1(config-if)# ip ospf priority 150

   R2(config)# interface fastethernet 0/0
   R2(config-if)# ip ospf priority 100

   R3(config)# interface fastethernet 0/0
   R3(config-if)# ip ospf priority 70

   R4(config)# interface fastethernet 0/0
   R4(config-if)# ip ospf priority 60

VERIFICATION:

➔ **To verify neighbour router status**

R3# show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.3.1	150	FULL/DR	00:00:38	192.168.5.1	FastEthernet0/0
20.1.1.1	100	FULL/BDR	00:00:32	192.168.5.2	FastEthernet0/0
40.1.3.1	60	2WAY/DROTHER	00:00:39	192.168.5.4	FastEthernet0/0

To verify your router status

R3#show ip ospf interface fastethernet 0/0

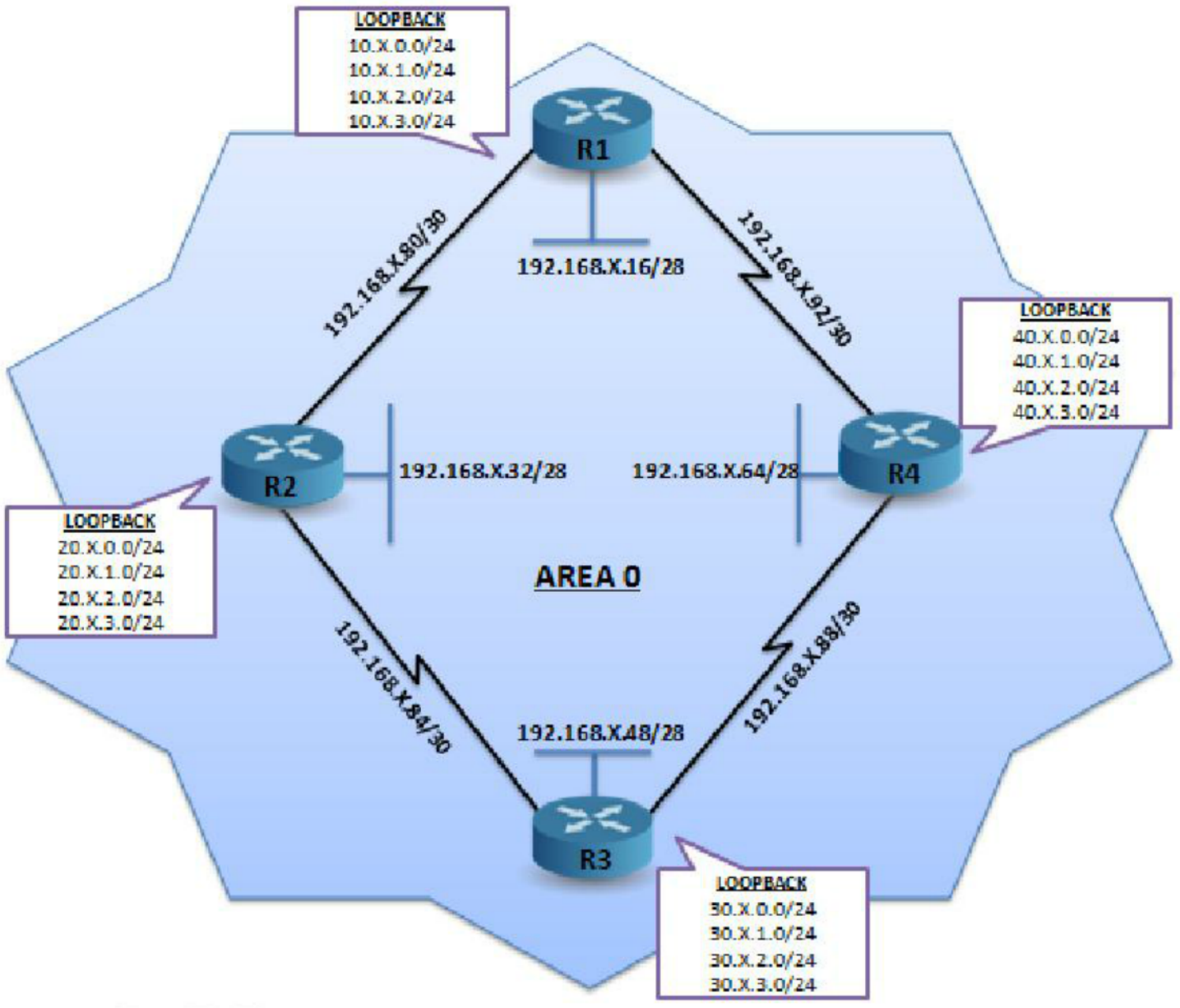
```
FastEthernet0/0 is up, line protocol is up
 Internet Address 192.168.5.3/24, Area 0
 Process ID 100, Router ID 30.1.3.1, Network Type BROADCAST, Cost: 1
 Topology-MTID   Cost    Disabled    Shutdown      Topology Name
      0          1       no          no            Base
 Transmit Delay is 1 sec, State DROTHER, Priority 70
 Designated Router (ID) 10.1.3.1, Interface address 192.168.5.1
 Backup Designated router (ID) 20.1.1.1, Interface address 192.168.5.2
 Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
 oob-resync timeout 40
 Hello due in 00:00:08
 Supports Link-local Signaling (LLS)
 Cisco NSF helper support enabled
 IETF NSF helper support enabled
 Index 1/1, flood queue length 0
 Next 0x0(0)/0x0(0)
 Last flood scan length is 0, maximum is 2
 Last flood scan time is 0 msec, maximum is 0 msec
 Neighbor Count is 3, Adjacent neighbor count is 2
 Adjacent with neighbor 10.1.3.1  (Designated Router)
 Adjacent with neighbor 20.1.1.1  (Backup Designated Router)
 Suppress hello for 0 neighbor(s)
```

LAB 7: OSPF CLEAR TEXT AUTHENTICATION

OBJECTIVE:

To configure OSPF Clear Text authentication between R1 and R2 routers

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure OSPF in all routers by using AREA 0
4) Verify Tables in OSPF
5) Configure clear text authentication between R1 router and R2 router. The password should be zoom.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers

```
R1 (config)#router ospf 100
R1 (config-router)# network 10.X.0.0 0.0.255.255 area 0
R1 (config-router)# network 192.168.X.16 0.0.0.15 area 0
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
R1 (config-router)# network 192.168.X.92 0.0.0.3 area 0
R2 (config)#router ospf 100
R2 (config-router)#network 20.X.0.0 0.0.255.255 area 0
R2 (config-router) #network 192.168.X.32 0.0.0.15 area 0
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0
R3(config)#router ospf  100
R3(config-router)# network 30.X.0.0 0.0.255.255 area 0
 R3(config-router)#network 192.168.X.48 0.0.0.15 area 0
R3(config-router) #network 192.168.X.84 0.0.0.3 area 0
R3(config-router) #network 192.168.X.88 0.0.0.3 area 0
R4(Config)# router ospf 100
R4(Config-router)#  network 40.X.0.0 0.0.255.255 area 0
 R4(Config-router)#  network 192.168.X.64 0.0.0.15 area 0
 R4 (Config-router)#  network 192.168.X.88 0.0.0.3 area 0
 R4(Config-router)#  network 192.168.X.92 0.0.0.3 area 0
```

4) Verify Tables in OSPF before configuring authentication in all the routers

```
Router# show ip ospf neighbor
Router# show ip ospf database
Router# show ip route
```

5) Configure clear text authentication on the serial interfaces between R1 router and R2 router.

   The password should be zoom.

   R1#show cdp neighbors

```
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID      Local Intrfce     Holdtme    Capability  Platform      Port ID
R2             Ser 0/1/1         153           R S I           2811          Ser 0/0/1
R4             Ser 0/1/0         173           R S I           2811          Ser 0/0/0
```

```
R1(config)#interface serial 0/1/1
R1(config-if)# ip ospf authentication
```

R1(config-if)# ip ospf authentication-key zoom
R2#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R3	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R1	Ser 0/1/0	173	R S I	2811	Ser 0/0/0

R2(config)#interface serial 0/0/1
R2(config-if)#ip ospf authentication
R2(config-if)#ip ospf authentication-key zoom

VERIFICATION:

➔ **To check whether OSPF authentication is enabled or not**

R2#show ip ospf interface serial 0/0/1

Serial0/0/1 is up, line protocol is up
Internet Address 192.168.1.82/30, Area 0
Process ID 100, Router ID 20.1.3.1, Network Type POINT_TO_POINT, Cost: 781

Topology-MTID	Cost	Disabled	Shutdown	Topology Name
0	781	no	no	Base

Transmit Delay is 1 sec, State POINT_TO_POINT
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5 oob-resync timeout 40
Hello due in 00:00:05
Supports Link-local Signaling (LLS)
Cisco NSF helper support enabled
IETF NSF helper support enabled
Index 4/4, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 2
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 10.1.3.1
Suppress hello for 0 neighbor(s)
Simple password authentication enabled

R1#show ip ospf interface serial 0/1/1
Serial0/1/1 is up, line protocol is up
Internet Address 192.168.1.81/30, Area 0
Process ID 100, Router ID 10.1.3.1, Network Type POINT_TO_POINT, Cost: 781

Topology-MTID	Cost	Disabled	Shutdown	Topology Name
0	781	no	no	Base

Transmit Delay is 1 sec, State POINT_TO_POINT
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5 oob-resync timeout 40
Hello due in 00:00:01
Supports Link-local Signaling (LLS)
Cisco NSF helper support enabled
IETF NSF helper support enabled
Index 3/3, flood queue length 0
Next 0x0(0)/0x0(0)

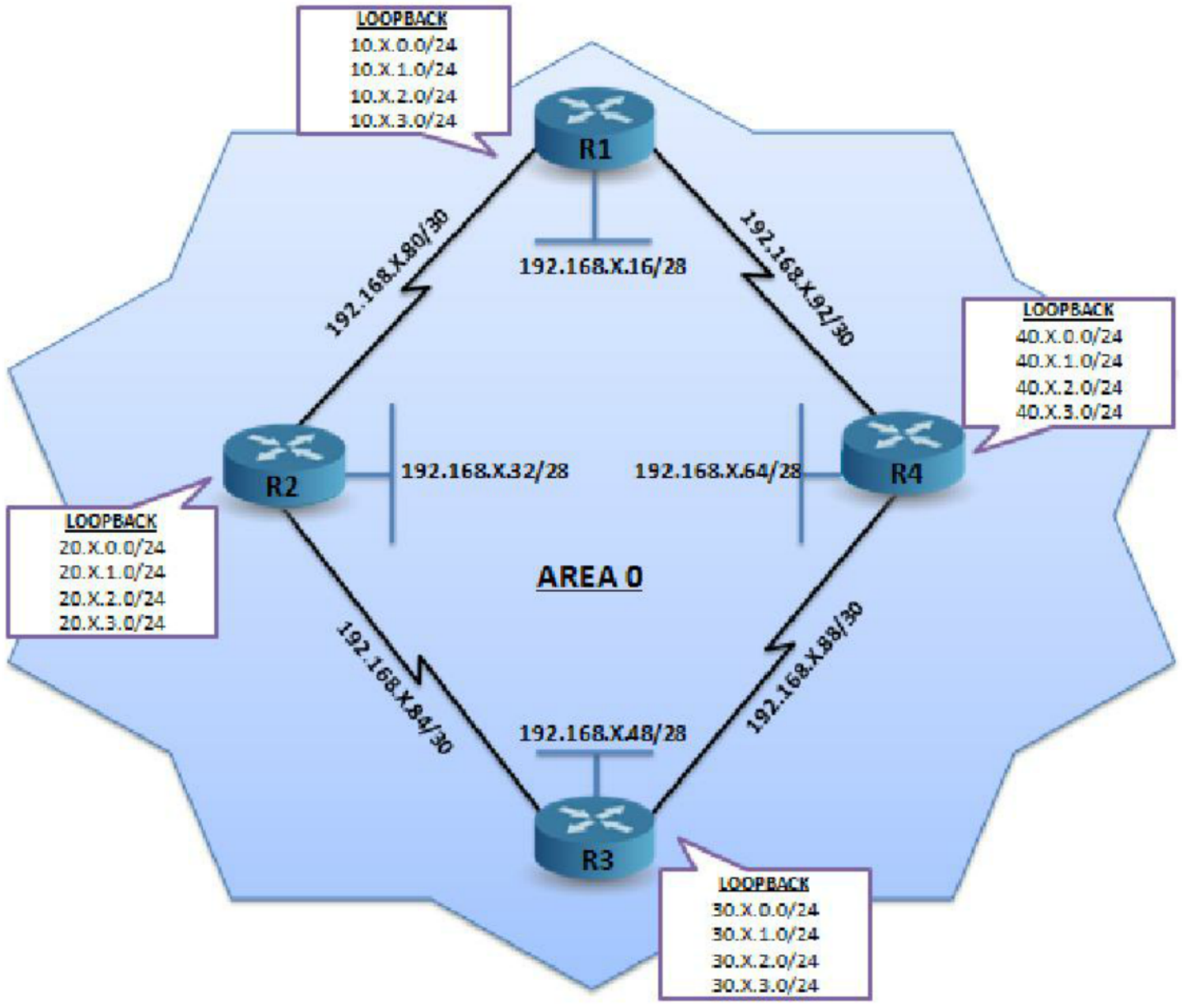
```
Last flood scan length is 1, maximum is 2
Last flood scan time is 0 msec, maximum is 4 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 20.1.3.1
Suppress hello for 0 neighbor(s)
Simple password authentication enabled
```

LAB 8: OSPF MD-5 AUTHENTICATION

OBJECTIVE:

To configure OSPF MD-5 authentication between R1 and R2 routers

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure OSPF in all routers by using AREA 0
4) Verify Tables in OSPF
5) Configure Message Digest authentication between R1 router and R2 router. The key number is 1 and Key name should be zoom.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers

   R1 (config)#router ospf 100
   R1 (config-router)# network 10.X.0.0 0.0.255.255 area 0
   R1 (config-router)# network 192.168.X.16 0.0.0.15 area 0
   R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
   R1 (config-router)# network 192.168.X.92 0.0.0.3 area 0
   R2 (config)#router ospf 100
   R2 (config-router)#network 20.X.0.0 0.0.255.255 area 0
   R2 (config-router) #network 192.168.X.32 0.0.0.15 area 0
   R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
   R2(config-router) #network 192.168.X.84 0.0.0.3 area 0
   R3(config)#router ospf 100
   R3(config-router)# network 30.X.0.0 0.0.255.255 area 0
   R3(config-router)#network 192.168.X.48 0.0.0.15 area 0
   R3(config-router) #network 192.168.X.84 0.0.0.3 area 0
   R3(config-router) #network 192.168.X.88 0.0.0.3 area 0
   R4(Config)# router ospf 100
   R4(Config-router)# network 40.X.0.0 0.0.255.255 area 0
   R4(Config-router)# network 192.168.X.64 0.0.0.15 area 0
   R4 (Config-router)# network 192.168.X.88 0.0.0.3 area 0
   R4(Config-router)# network 192.168.X.92 0.0.0.3 area 0

4) Verify Tables in OSPF before configuring authentication in all the routers

   Router# show ip ospf neighbor

   Router# show ip ospf database

   Router# show ip route

5) Configure Message Digest authentication on the serial interfaces between R1 and R2. The key number should be 1 and Key name should be zoom.

   R1#show cdp neighbors

   Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge

   S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,

   D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R2	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	173	R S I	2811	Ser 0/0/0

R1(config)#interface serial 0/1/1

R1(config-if)# ip ospf authentication message-digest

R1(config-if)# ip ospf message-digest-key 1 md5 zoom

R2#show cdp neighbors

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge

S - Switch, H - Host, I - IGMP, r - Repeater

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R3	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R1	Ser 0/0/1	173	R S I	2811	Ser 0/1/1

R2(config)#interface serial 0/0/1

R2(config-if)#ip ospf authentication message-digest

R2(config-if)#ip ospf messege-digest-key 1 md5 zoom

VERIFICATION:

➔ **To check whether OSPF authentication is enabled or not**

R2#show ip ospf interface serial 0/0/1

Serial0/0/1 is up, line protocol is up
Internet Address 192.168.1.82/30, Area 0
Process ID 100, Router ID 20.1.3.1, Network Type POINT_TO_POINT, Cost: 781
Topology-MTID Cost Disabled Shutdown Topology Name
0 781 no no Base
Transmit Delay is 1 sec, State POINT_TO_POINT
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5 oob-resync timeout 40
Hello due in 00:00:05
Supports Link-local Signaling (LLS)
Cisco NSF helper support enabled
IETF NSF helper support enabled
Index 4/4, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 2
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 10.1.3.1
Suppress hello for 0 neighbor(s)
Message digest authentication enabled
Youngest key id is 1

R1#show ip ospf interface serial 0/1/1

Serial0/1/1 is up, line protocol is up

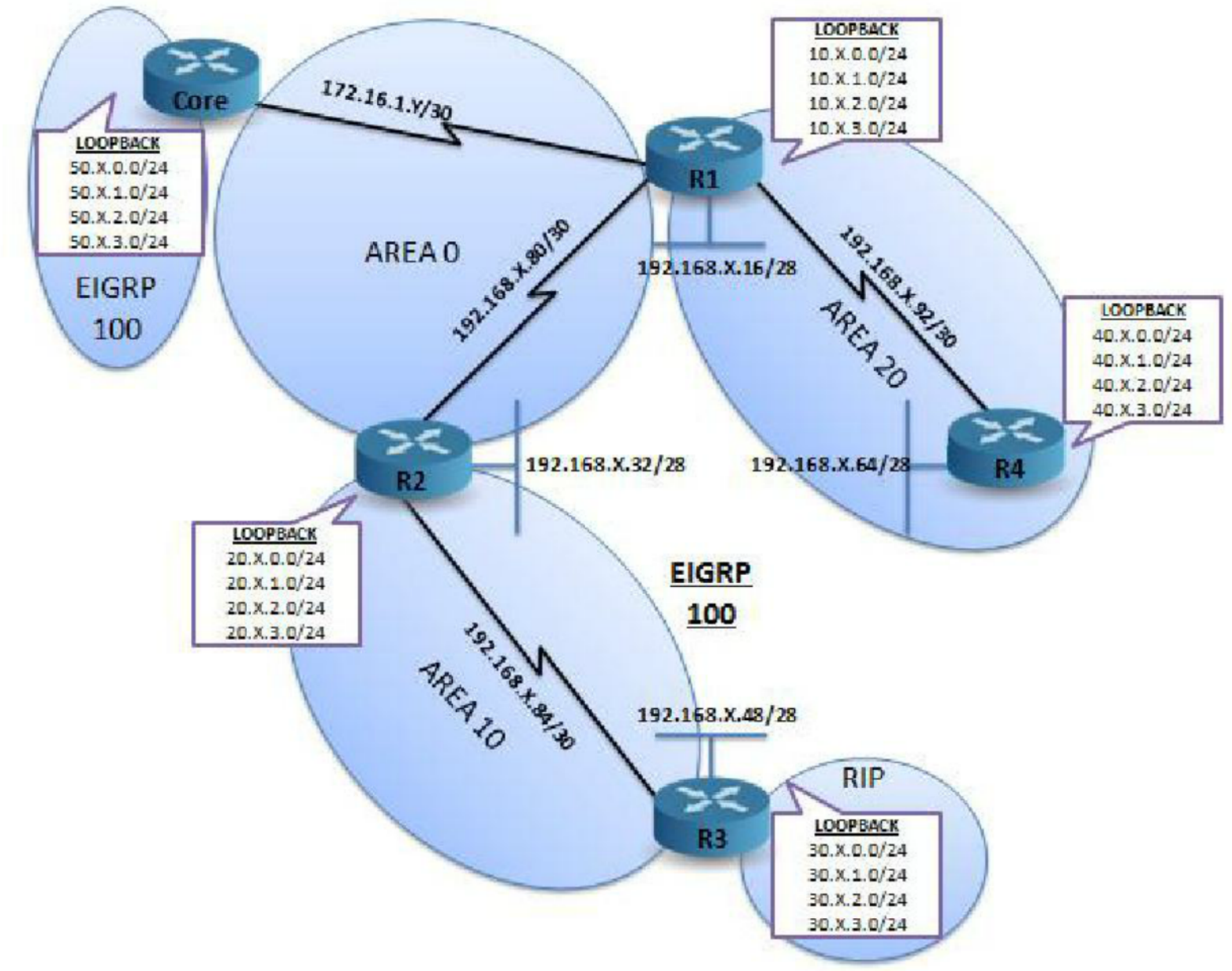
```
Internet Address 192.168.1.81/30, Area 0
Process ID 100, Router ID 10.1.3.1, Network Type POINT_TO_POINT, Cost: 781
Topology-MTID    Cost    Disabled    Shutdown      Topology Name
        0        781       no          no          Base
Transmit Delay is 1 sec, State POINT_TO_POINT
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5 oob-resync timeout 40
Hello due in 00:00:01
Supports Link-local Signaling (LLS)
Cisco NSF helper support enabled
IETF NSF helper support enabled
Index 3/3, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 2
Last flood scan time is 0 msec, maximum is 4 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 20.1.3.1
Suppress hello for 0 neighbor(s)
Message digest authentication enabled

 Youngest key id is 1
```

LAB 9: MULTI AREAOSPF

OBJECTIVE:

To configure OSPF routers in multiple areas with a central backbone area (area 0)

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in Multi Area OSPF as per given topology.
4) Configure redistribution from RIP and EIGRP
5) Verify Tables in OSPF.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

Router# show ip route

3) Configure OSPF on all routers

R1(config)# router ospf 100
R1(config-router)#network 192.168.X.16 0.0.0.15 area 20
R1(config-router)#network 192.168.X.80 0.0.0.3 area 0
R1(config-router)#network 192.168.X.92 0.0.0.3 area 20
R1(config-router)# network 10.X.0.0 0.0.0.255.255 area 20
R1(config-router)#exit
R2(config)#router ospf 100
R2(Config-router)#network 192.168.X.80 0.0.0.3 area 0
R2(Config-router)#network 192.168.X.32 0.0.0.15 area 10
R2(Config-router)#network 192.168.X.84 0.0.0.3 area 10
R2(Config-router)#network 20.X.0.0 0.0.255.255 area 10
R2(Config-router)#exit
R3(config)#router ospf 100
R3(config-router)# network 192.168.X.0 0.0.0.255 area 10
R3(config-router)#exit
R3(config)#router rip
R3(config-router)#version 2
R3(config-router)#network 30.0.0.0
R3(config-router)#no auto-summary
R3(config-router)#exit
R4(config)#router ospf 100
R4(config-router)# network 192.168.X.0 0.0.0.255 area 20
R4(config-router)#network 40.X.0.0 0.0.255.255 area 20
R4(config-router)#end
Core(config)# router ospf 100
Core(config-router)# network 172.16.X.0 0.0.0.3 area 0
core(config)#router eigrp 100
core(config-router)#no auto-summary
core(config-router)#network 50.0.0.0
core(config-router)#exit

4) Configure redistribution of RIP routes from R3 Router and EIGRP router from Core into OSPF.

R3(config)#router ospf 100
R3(config-router)#redistribute rip subnets
Core(config)# router ospf 100
Core(config-router)#redistribute eigrp 100 subnets

VERIFICATION:

➔ **Check OSPF Neighbor Table in all the routers.**

R1,R2,R3,R4# show ip ospf neighbour
R4# show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.3.1	0	FULL/-	00:00:37	192.168.1.94	Serial0/0/0

->Check OSPF Database Table in all the routers.
R1,R2,R3, R4#show ip ospf database
R4#show ip ospf database

OSPF Router with ID (40.1.3.1) (Process ID 1)

Router Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	564	0x80000003	0x00E768	6
40.1.3.1	40.1.3.1	142	0x80000004	0x00E2AA	8

Summary Net Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
20.1.0.1	10.1.3.1	199	0x80000001	0x00986E
20.1.1.1	10.1.3.1	199	0x80000001	0x008D78
20.1.3.1	10.1.3.1	199	0x80000001	0x00778C
172.16.1.0	10.1.3.1	759	0x80000001	0x00FD32
172.16.1.3	10.1.3.1	759	0x80000001	0x006BB4
192.168.1.32	10.1.3.1	199	0x80000001	0x005B46
192.168.1.80	10.1.3.1	759	0x80000001	0x00B7AE
192.168.1.84	10.1.3.1	199	0x80000001	0x00CA77

Summary ASB Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
30.1.3.1	10.1.3.1	199	0x80000001	0x0018C1
40.1.3.1	10.1.3.1	22	0x80000001	0x003F80

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	84	0x80000001	0x00015A	0
50.1.0.0	40.1.3.1	3606	0x80000006	0x00EF5F	0
50.1.1.0	40.1.3.1	3606	0x80000006	0x00E469	0
50.1.2.0	40.1.3.1	3606	0x80000006	0x00D973	0
50.1.3.0	40.1.3.1	3606	0x80000006	0x00CE7D	0

➔ **Check Routing Table in all the routers.**

R1,R2,R3,R4# show ip route

R1# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     20.0.0.0/32 is subnetted, 3 subnets
O IA    20.1.0.1 [110/782] via 192.168.1.82, 00:34:44, Serial0/1/1
O IA    20.1.1.1 [110/782] via 192.168.1.82, 00:34:44, Serial0/1/1
O IA    20.1.3.1 [110/782] via 192.168.1.82, 00:34:44, Serial0/1/1
```

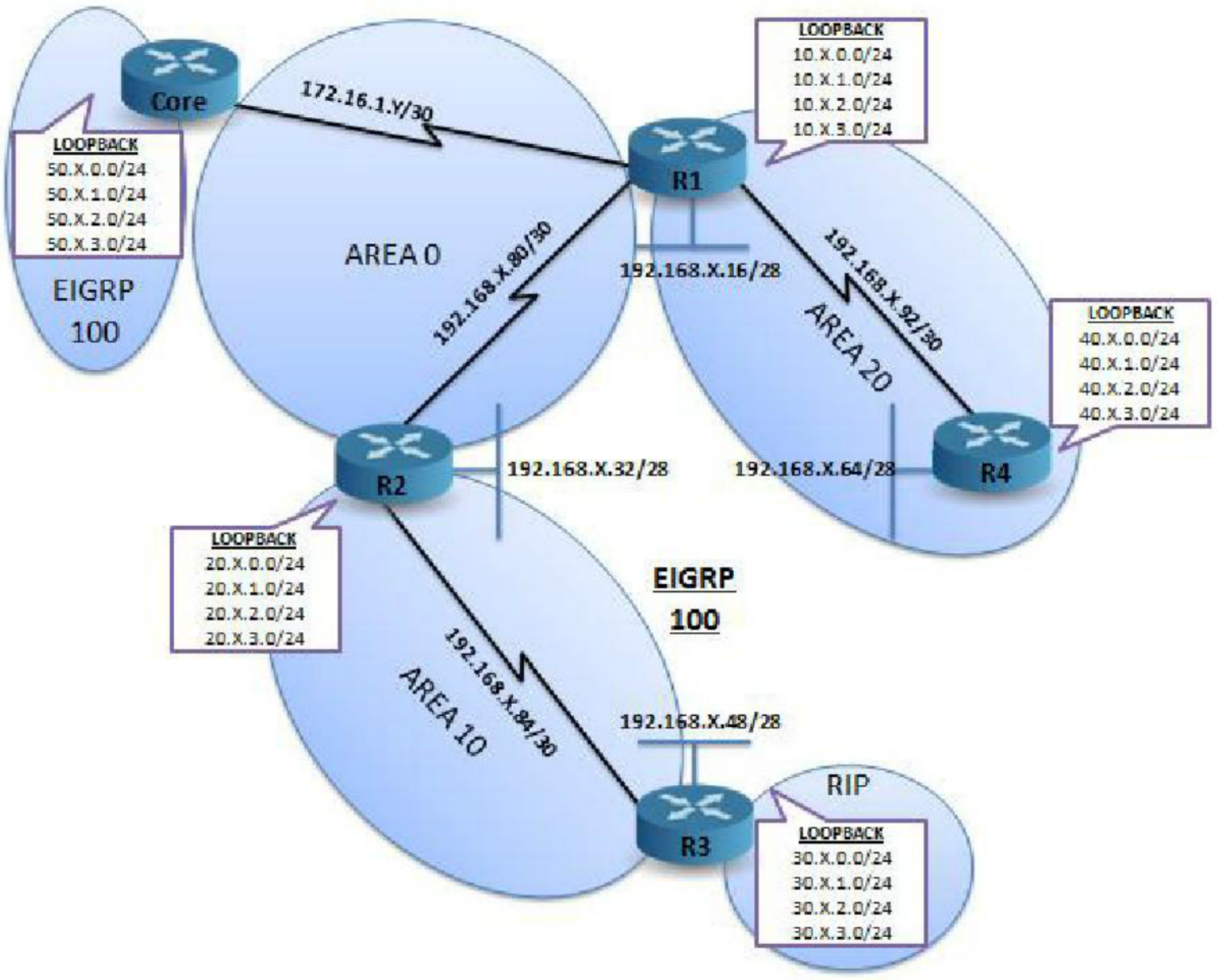
```
     30.0.0.0/24 is subnetted, 1 subnets
O E2    30.1.3.0 [110/20] via 192.168.1.82, 00:32:47, Serial0/1/1
     40.0.0.0/32 is subnetted, 4 subnets
O       40.1.0.1 [110/782] via 192.168.1.93, 00:40:45, Serial0/1/0
O       40.1.1.1 [110/782] via 192.168.1.93, 00:40:45, Serial0/1/0
O       40.1.2.1 [110/782] via 192.168.1.93, 00:40:45, Serial0/1/0
O       40.1.3.1 [110/782] via 192.168.1.93, 00:40:45, Serial0/1/0
     50.0.0.0/24 is subnetted, 4 subnets
O E2    50.1.0.0 [110/20] via 172.16.1.1, 00:00:04, Serial0/3/1
O E2    50.1.1.0 [110/20] via 172.16.1.1, 00:00:04, Serial0/3/1
O E2    50.1.2.0 [110/20] via 172.16.1.1, 00:00:04, Serial0/3/1
O E2    50.1.3.0 [110/20] via 172.16.1.1, 00:00:03, Serial0/3/1
     172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C       172.16.1.0/24 is directly connected, Serial0/3/1
O       172.16.1.0/30 [110/845] via 172.16.1.1, 00:44:04, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
O IA    192.168.1.32/28 [110/782] via 192.168.1.82, 00:34:44, Serial0/1/1
O       192.168.1.64/28 [110/782] via 192.168.1.93, 00:33:43, Serial0/1/0
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
O IA    192.168.1.84/30 [110/2343] via 192.168.1.82, 00:34:44, Serial0/1/1
O       192.168.1.88/30 [110/1562] via 192.168.1.93, 00:40:45, Serial0/1/0
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

LAB 10: OSPF INTERNAL SUMMARIZATION

OBJECTIVE:

To configure and verify Internal Summarization in OSPF

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in Multi Area OSPF as per given topology.
4) Verify Tables in OSPF.
5) Verify the Internal Summarization in OSPF

STEPS:

1) Verify the interface status by using Show ip interface brief command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers as done in Multi Area OSPF lab.

4) Verify Tables in OSPF before configuring authentication in all the routers

   Router# show ip ospf neighbor
   Router# show ip ospf database
   Router# show ip route

5) Before Summarization

   R2# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
     10.0.0.0/32 is subnetted, 3 subnets
O IA    10.1.1.1 [110/782] via 192.168.1.81, 00:43:40, Serial0/0/1
O IA    10.1.2.1 [110/782] via 192.168.1.81, 00:43:40, Serial0/0/1
O IA    10.1.3.1 [110/782] via 192.168.1.81, 00:43:40, Serial0/0/1
     20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     30.0.0.0/24 is subnetted, 1 subnets
O E2    30.1.3.0 [110/20] via 192.168.1.86, 00:41:44, Serial0/0/0
     40.0.0.0/32 is subnetted, 4 subnets
O IA    40.1.0.1 [110/1563] via 192.168.1.81, 00:43:40, Serial0/0/1
O IA    40.1.1.1 [110/1563] via 192.168.1.81, 00:43:40, Serial0/0/1
O IA    40.1.2.1 [110/1563] via 192.168.1.81, 00:43:40, Serial0/0/1
O IA    40.1.3.1 [110/1563] via 192.168.1.81, 00:43:40, Serial0/0/1
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
O       172.16.1.0/24 [110/845] via 192.168.1.81, 00:43:40, Serial0/0/1
O       172.16.1.0/30 [110/1626] via 192.168.1.81, 00:43:40, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O IA    192.168.1.16/28 [110/782] via 192.168.1.81, 00:43:40, Serial0/0/1
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
```

O IA 192.168.1.64/28 [110/1563] via 192.168.1.81, 00:42:40, Serial0/0/1
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
O IA 192.168.1.88/30 [110/2343] via 192.168.1.81, 00:43:40, Serial0/0/1
O IA 192.168.1.92/30 [110/1562] via 192.168.1.81, 00:43:40, Serial0/0/1

6) Configure Internal Summarization in R1 router for 40.0.0.0 networks.

R1 (config)# router ospf 100
R1 (config-router)#area 20 range 40.X.0.0 255.255.252.0
Note: Internal Summarization should be configured only on Area Border Routers.

VERIFICATION:

➔ **After Summarization**

R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
10.0.0.0/32 is subnetted, 3 subnets
O IA 10.1.1.1 [110/782] via 192.168.1.81, 00:44:29, Serial0/0/1
O IA 10.1.2.1 [110/782] via 192.168.1.81, 00:44:29, Serial0/0/1
O IA 10.1.3.1 [110/782] via 192.168.1.81, 00:44:29, Serial0/0/1
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
30.0.0.0/24 is subnetted, 1 subnets
O E2 30.1.3.0 [110/20] via 192.168.1.86, 00:42:33, Serial0/0/0
40.0.0.0/22 is subnetted, 1 subnets
O IA 40.1.0.0 [110/1563] via 192.168.1.81, 00:00:07, Serial0/0/1
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
O 172.16.1.0/24 [110/845] via 192.168.1.81, 00:44:29, Serial0/0/1
O 172.16.1.0/30 [110/1626] via 192.168.1.81, 00:44:29, Serial0/0/1
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O IA 192.168.1.16/28 [110/782] via 192.168.1.81, 00:44:29, Serial0/0/1
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
O IA 192.168.1.64/28 [110/1563] via 192.168.1.81, 00:43:29, Serial0/0/1
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1

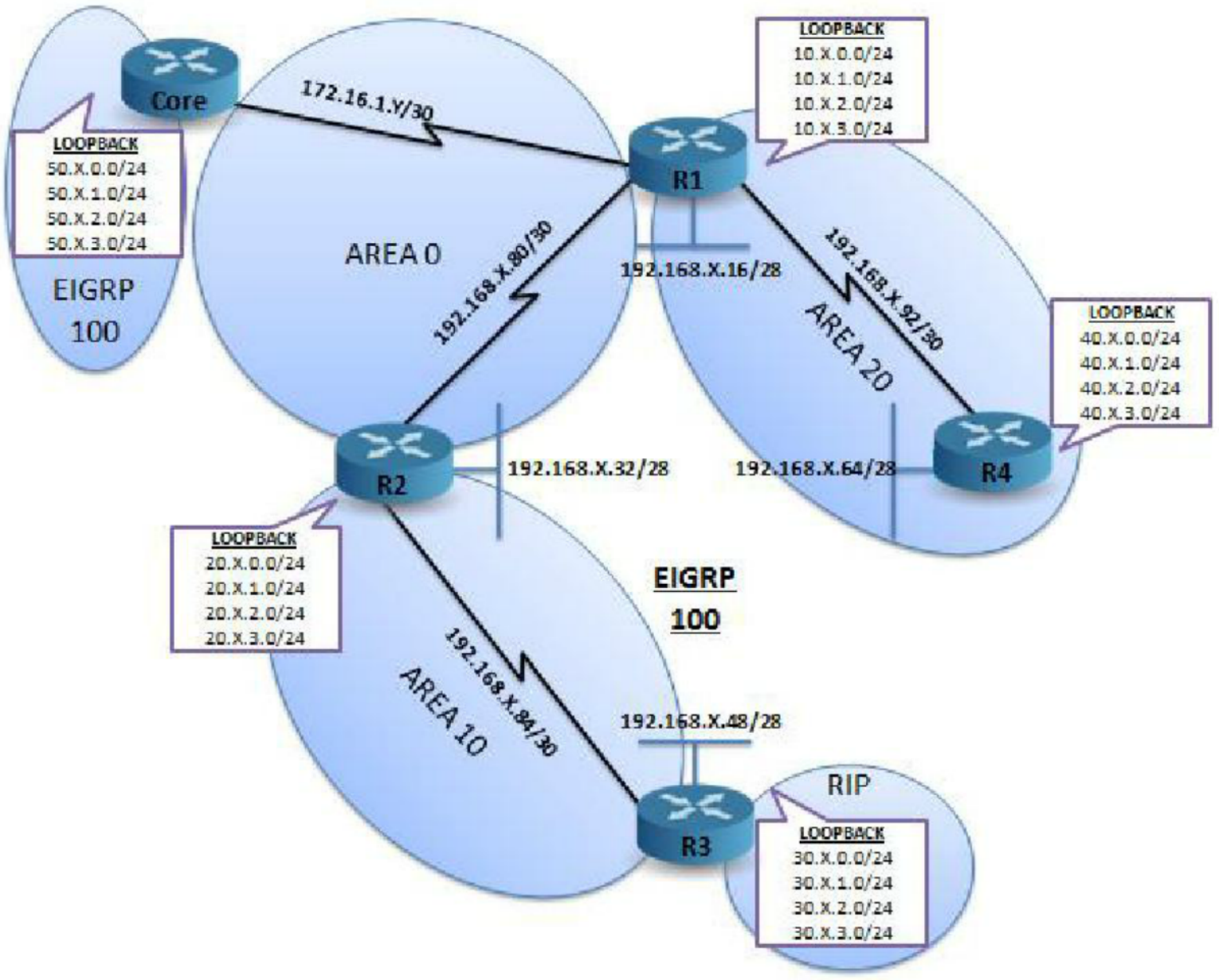
```
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
O IA    192.168.1.88/30 [110/2343] via 192.168.1.81, 00:44:29, Serial0/0/1
O IA    192.168.1.92/30 [110/1562] via 192.168.1.81, 00:44:29, Serial0/0/1
```

LAB 11: OSPF EXTERNAL SUMMARIZATION

OBJECTIVE:

To configure and verify External Summarization in OSPF

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in Multi Area OSPF as per given topology.
4) Verify Tables in OSPF.
5) Check routing tables before summarization
6) Verify the External Summarization in OSPF

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers as done in Multi Area OSPF Lab.

4) Verify Tables in OSPF before configuring authentication in all the routers

   Router# show ip ospf neighbor
   Router# show ip ospf database
   Router# show ip route

5) Verify routing tables before summarization

➔ **Before Summarization**

R1# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     20.0.0.0/32 is subnetted, 3 subnets
O IA    20.1.0.1 [110/782] via 192.168.1.82, 00:04:42, Serial0/1/1
O IA    20.1.1.1 [110/782] via 192.168.1.82, 00:04:42, Serial0/1/1
O IA    20.1.3.1 [110/782] via 192.168.1.82, 00:04:42, Serial0/1/1
     30.0.0.0/24 is subnetted, 1 subnets
O E2    30.1.3.0 [110/20] via 192.168.1.82, 00:04:42, Serial0/1/1
     40.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
O       40.1.0.0/22 is a summary, 00:04:42, Null0
O       40.1.0.1/32 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0
O       40.1.1.1/32 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0
O       40.1.2.1/32 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0
        40.1.3.1/32 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0
```

```
50.0.0.0/24 is subnetted, 4 subnets
O E2    50.1.0.0 [110/20] via 172.16.1.1, 00:00:05, Serial0/3/1
O E2    50.1.1.0 [110/20] via 172.16.1.1, 00:00:01, Serial0/3/1
O E2    50.1.2.0 [110/20] via 172.16.1.1, 00:00:02, Serial0/3/1
O E2    50.1.3.0 [110/20] via 172.16.1.1, 00:00:01, Serial0/3/1
    172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C       172.16.1.0/24 is directly connected, Serial0/3/1
O       172.16.1.0/30 [110/845] via 172.16.1.1, 00:04:42, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
    192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
O IA    192.168.1.32/28 [110/782] via 192.168.1.82, 00:04:42, Serial0/1/1
O       192.168.1.64/28 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
O IA    192.168.1.84/30 [110/2343] via 192.168.1.82, 00:04:42, Serial0/1/1
O       192.168.1.88/30 [110/1562] via 192.168.1.93, 00:04:42, Serial0/1/0
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

6) Configure External Summarization in Core router.

Core (config)# router ospf 100
Core (config-router)#summary-address 50.X.0.0 255.255.252.0
Note: External Summarization should be configured on Autonomous System Boundary Routers only.

VERIFICATION:

➔ **After Summarization**

R1#show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set
    10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
    20.0.0.0/32 is subnetted, 3 subnets
O IA    20.1.0.1 [110/782] via 192.168.1.82, 00:04:50, Serial0/1/1
```

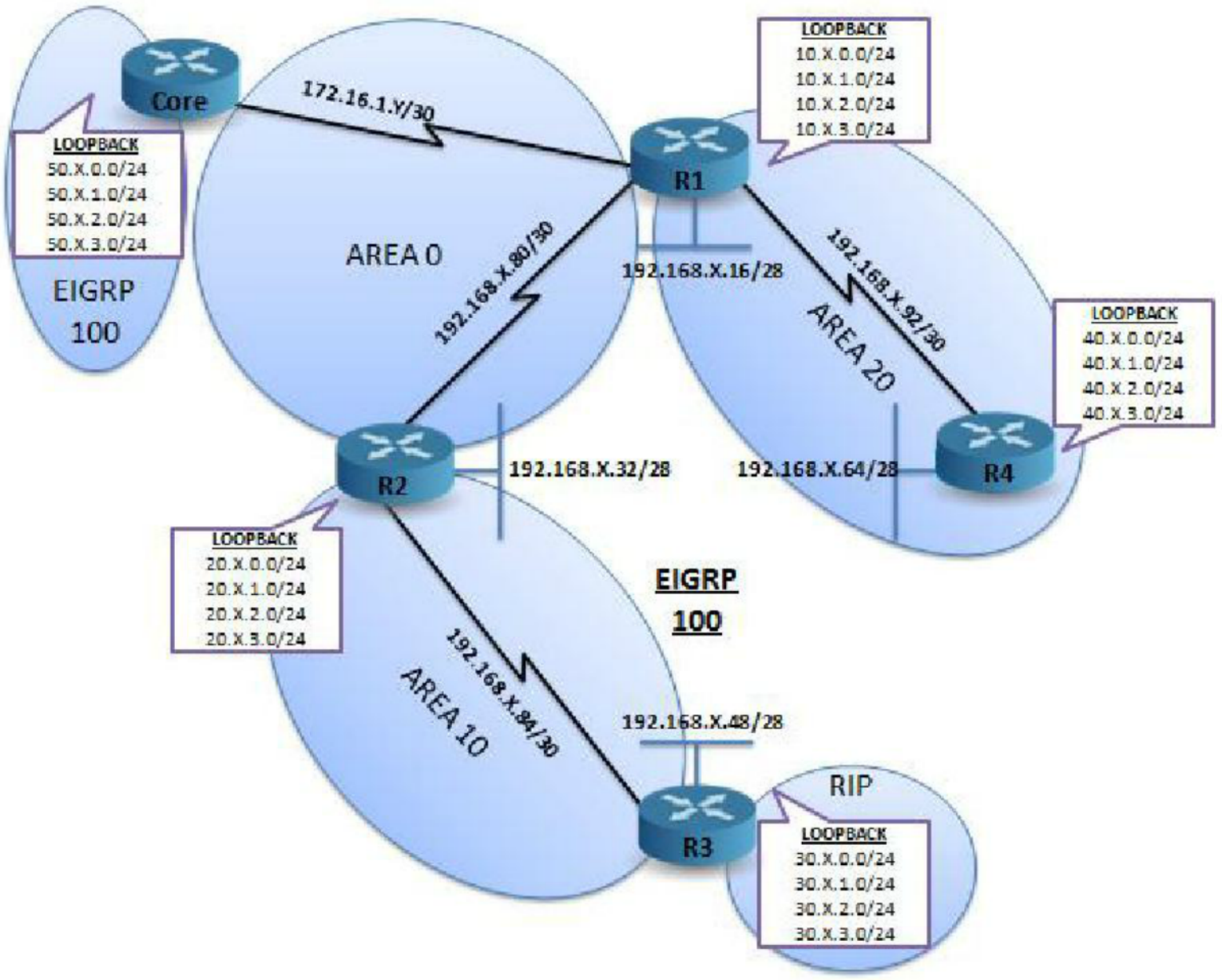
```
O IA    20.1.1.1 [110/782] via 192.168.1.82, 00:04:50, Serial0/1/1
O IA    20.1.3.1 [110/782] via 192.168.1.82, 00:04:50, Serial0/1/1
    30.0.0.0/24 is subnetted, 1 subnets
O E2    30.1.3.0 [110/20] via 192.168.1.82, 00:04:50, Serial0/1/1
    40.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
O       40.1.0.0/22 is a summary, 00:04:50, Null0
O       40.1.0.1/32 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0
O       40.1.1.1/32 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0
O       40.1.2.1/32 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0
O       40.1.3.1/32 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0
50.0.0.0/24 is subnetted, 2 subnets
O E2    50.1.0.0 [110/20] via 172.16.1.1, 00:00:13, Serial0/3/1
    172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C       172.16.1.0/24 is directly connected, Serial0/3/1
O       172.16.1.0/30 [110/845] via 172.16.1.1, 00:04:50, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
    192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
O IA    192.168.1.32/28 [110/782] via 192.168.1.82, 00:04:50, Serial0/1/1
O       192.168.1.64/28 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
O IA    192.168.1.84/30 [110/2343] via 192.168.1.82, 00:04:50, Serial0/1/1
O       192.168.1.88/30 [110/1562] via 192.168.1.93, 00:04:50, Serial0/1/0
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

LAB 12: OSPF STUB AREA

OBJECTIVE:

To configure and verify STUB AREA in OSPF

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in Multi Area OSPF as per given topology.
4) Verify Tables in OSPF
5) Configure Area 20 as STUB Area

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers as in Multi Area OSPFexercise.

4) Verify Tables in OSPF before configuring authentication in all the routers

   Router# show ip ospf neighbor
   Router# show ip ospf database
   Router# show ip route

5) Check OSPF database before configuring area 20 as stub

   R4#show ip ospf database

OSPF Router with ID (40.1.3.1) (Process ID 1)

Router Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	242	0x80000005	0x00E36A	6
40.1.3.1	40.1.3.1	354	0x80000009	0x00D8AF	8

Summary Net Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
20.1.0.1	10.1.3.1	1986	0x80000002	0x00966F
20.1.1.1	10.1.3.1	1986	0x80000002	0x008B79
20.1.3.1	10.1.3.1	1986	0x80000002	0x00758D
172.16.1.0	10.1.3.1	500	0x80000003	0x00F934
172.16.1.3	10.1.3.1	500	0x80000003	0x0067B6
192.168.1.32	10.1.3.1	1986	0x80000002	0x005947
192.168.1.80	10.1.3.1	500	0x80000003	0x00B3B0
192.168.1.84	10.1.3.1	1986	0x80000002	0x00C878

Summary ASB Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
30.1.3.1	10.1.3.1	1986	0x80000002	0x0016C2
40.1.3.1	10.1.3.1	1736	0x80000002	0x003D81

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	1885	0x80000002	0x00FE5B	0
50.1.0.0	40.1.3.1	3606	0x80000306	0x00D777	0

6) Configure AREA 20 as STUB AREA

   R1(config)# router ospf 100
   R1(config-router)# area 20 stub

R4(config)# router ospf 100
R4(config-router)# area 20 stub

VERIFICATION:

➔ **After making the area 20 as stub area,**

R4#show ip ospf database

OSPF Router with ID (40.1.3.1) (Process ID 1)

Router Link States (Area 20)					
Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	7	0x80000007	0x00FD50	6
40.1.3.1	40.1.3.1	4	0x8000000B	0x00F295	8

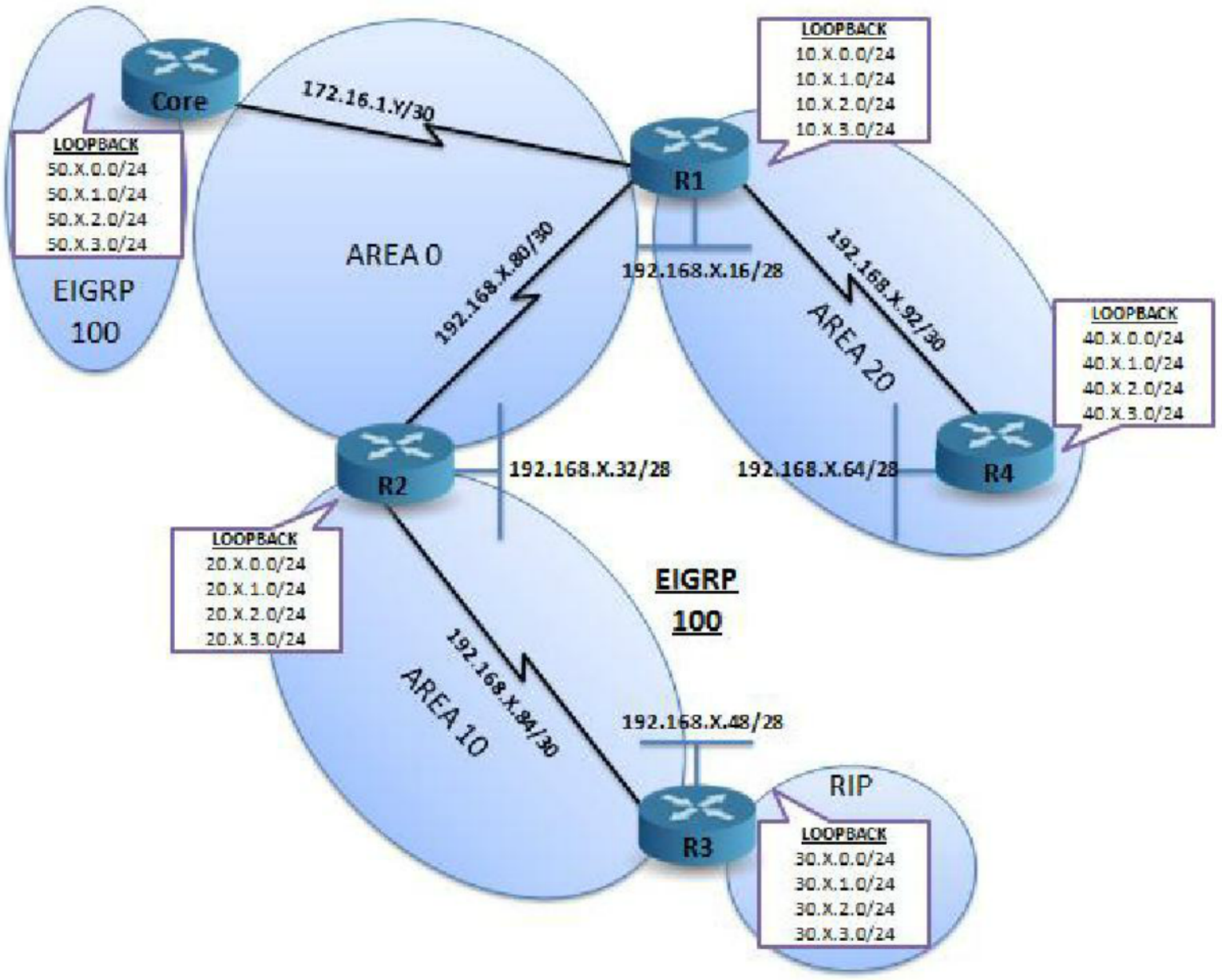
Summary Net Link States (Area 20)				
Link ID	ADV Router	Age	Seq#	Checksum
0.0.0.0	10.1.3.1	23	0x80000001	0x0034FA
20.1.0.1	10.1.3.1	23	0x80000004	0x00B055
20.1.1.1	10.1.3.1	23	0x80000004	0x00A55F
20.1.3.1	10.1.3.1	23	0x80000004	0x008F73
172.16.1.0	10.1.3.1	23	0x80000004	0x001619
172.16.1.3	10.1.3.1	23	0x80000004	0x00839B
192.168.1.32	10.1.3.1	23	0x80000004	0x00732D
192.168.1.80	10.1.3.1	23	0x80000004	0x00CF95
192.168.1.84	10.1.3.1	23	0x80000004	0x00E25E

LAB 13: OSPF TOTALLY STUBBY AREA

OBJECTIVE:

To configure and verify TOTALLY STUBBY AREA in OSPF

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in Multi Area OSPF as per given topology.
4) Verify Tables in OSPF.
5) Configure Area 20 as Totallystubby Area

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers as did in Multi Area OSPF Lab.

4) Verify Tables in OSPF before configuring authentication in all the routers

   Router# show ip ospf neighbor
   Router# show ip ospf database
   Router# show ip route

5) Check the OSPF database before making AREA 20 a Totally stubby area

   R4#show ip ospf database

OSPF Router with ID (40.1.3.1) (Process ID 1)

Router Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	242	0x80000005	0x00E36A	6
40.1.3.1	40.1.3.1	354	0x80000009	0x00D8AF	8

Summary Net Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
20.1.0.1	10.1.3.1	1986	0x80000002	0x00966F
20.1.1.1	10.1.3.1	1986	0x80000002	0x008B79
20.1.3.1	10.1.3.1	1986	0x80000002	0x00758D
172.16.1.0	10.1.3.1	500	0x80000003	0x00F934
172.16.1.3	10.1.3.1	500	0x80000003	0x0067B6
192.168.1.32	10.1.3.1	1986	0x80000002	0x005947
192.168.1.80	10.1.3.1	500	0x80000003	0x00B3B0
192.168.1.84	10.1.3.1	1986	0x80000002	0x00C878

Summary ASB Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
30.1.3.1	10.1.3.1	1986	0x80000002	0x0016C2
40.1.3.1	10.1.3.1	1736	0x80000002	0x003D81

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	1885	0x80000002	0x00FE5B	0
50.1.0.0	40.1.3.1	3606	0x80000306	0x00D777	0

6) Configure AREA 20 as a Totally stubby area

   R1(config)# router ospf 100
   R1(config-router)# area 20 stub no-summary

   R4(config)# router ospf 100
   R4(config-router)# area 20 stub

VERIFICATION:

➔ **After making the area 20 a Totally stubby area**

R4#show ip ospf database

OSPF Router with ID (40.1.3.1) (Process ID 1)

Router Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	7	0x80000007	0x00FD50	6
40.1.3.1	40.1.3.1	4	0x8000000B	0x00F295	8

Summary Net Link States (Area 20)

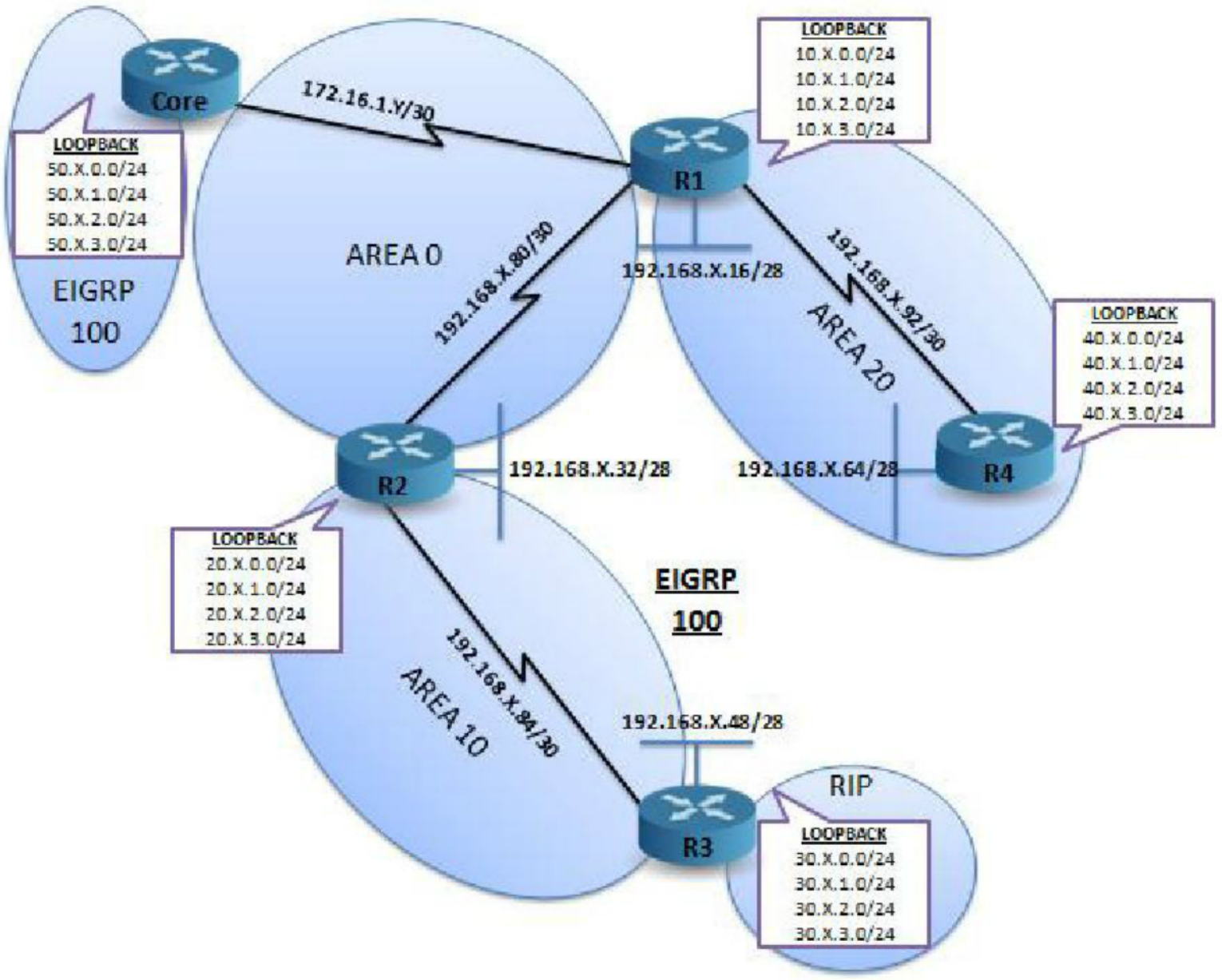
Link ID	ADV Router	Age	Seq#	Checksum
0.0.0.0	10.1.3.1	23	0x80000001	0x0034FA

LAB 14: OSPF NSSA

OBJECTIVE:

To configure and verify Not So Stubby Areas (NSSA) in OSPF

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in Multi Area OSPF as per given topology.
4) Verify Tables in OSPF.
5) Configure Area 10 as NSSA.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers as did in Multi Area OSPF lab.

4) Verify Tables in OSPF before configuring authentication in all the routers

   Router# show ip ospf neighbor
   Router# show ip ospf database
   Router# show ip route

5) Before Making AREA 10 as NSSA

   R3#show ip ospf database

OSPF Router with ID (30.1.3.1) (Process ID 100)

Router Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
20.1.3.1	20.1.3.1	802	0x80000006	0x00C344	6
30.1.3.1	30.1.3.1	760	0x80000005	0x007290	2

Summary Net Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
10.1.1.1	20.1.3.1	542	0x80000003	0x00B152
10.1.2.1	20.1.3.1	542	0x80000003	0x00A65C
10.1.3.1	20.1.3.1	542	0x80000003	0x009B66
40.1.0.0	20.1.3.1	131	0x80000001	0x00D10B
172.16.1.0	20.1.3.1	542	0x80000003	0x003DD6
172.16.1.3	20.1.3.1	542	0x80000003	0x00AA59
192.168.1.16	20.1.3.1	542	0x80000003	0x009D08
192.168.1.64	20.1.3.1	131	0x80000001	0x005D0A
192.168.1.80	20.1.3.1	1066	0x80000003	0x005901
192.168.1.88	20.1.3.1	131	0x80000001	0x0048EB
192.168.1.92	20.1.3.1	542	0x80000003	0x007EBF

Summary ASB Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
40.1.3.1	20.1.3.1	542	0x80000003	0x007E25

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	508	0x80000003	0x00FC5C	0
50.1.0.0	40.1.3.1	162	0x8000031F	0x006EB3	0

6) Configure AREA 10 as NSSA

   R2(config)# router ospf 100
   R2(config-router)# area 20 nssa

   R3(config)# router ospf 100
   R3(config-router)# area 20 nssa

VERIFICATION:

➔ **After making the area 10 as NSSA**

R3#show ip ospf database

OSPF Router with ID (30.1.3.1) (Process ID 1)

Router Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
20.1.3.1	20.1.3.1	13	0x80000008	0x006B92	6
30.1.3.1	30.1.3.1	15	0x80000007	0x0014E6	2

Summary Net Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
10.1.1.1	20.1.3.1	18	0x80000004	0x0055A7
10.1.2.1	20.1.3.1	18	0x80000004	0x004AB1
10.1.3.1	20.1.3.1	18	0x80000004	0x003FBB
40.1.0.0	20.1.3.1	18	0x80000002	0x007560
172.16.1.0	20.1.3.1	18	0x80000004	0x00E02C
172.16.1.3	20.1.3.1	18	0x80000004	0x004EAE
192.168.1.16	20.1.3.1	18	0x80000004	0x00415D
192.168.1.64	20.1.3.1	18	0x80000002	0x00015F
192.168.1.80	20.1.3.1	18	0x80000004	0x00FC56
192.168.1.88	20.1.3.1	18	0x80000002	0x00EB41
192.168.1.92	20.1.3.1	18	0x80000004	0x002215

Type-7 AS External Link States (Area 10)

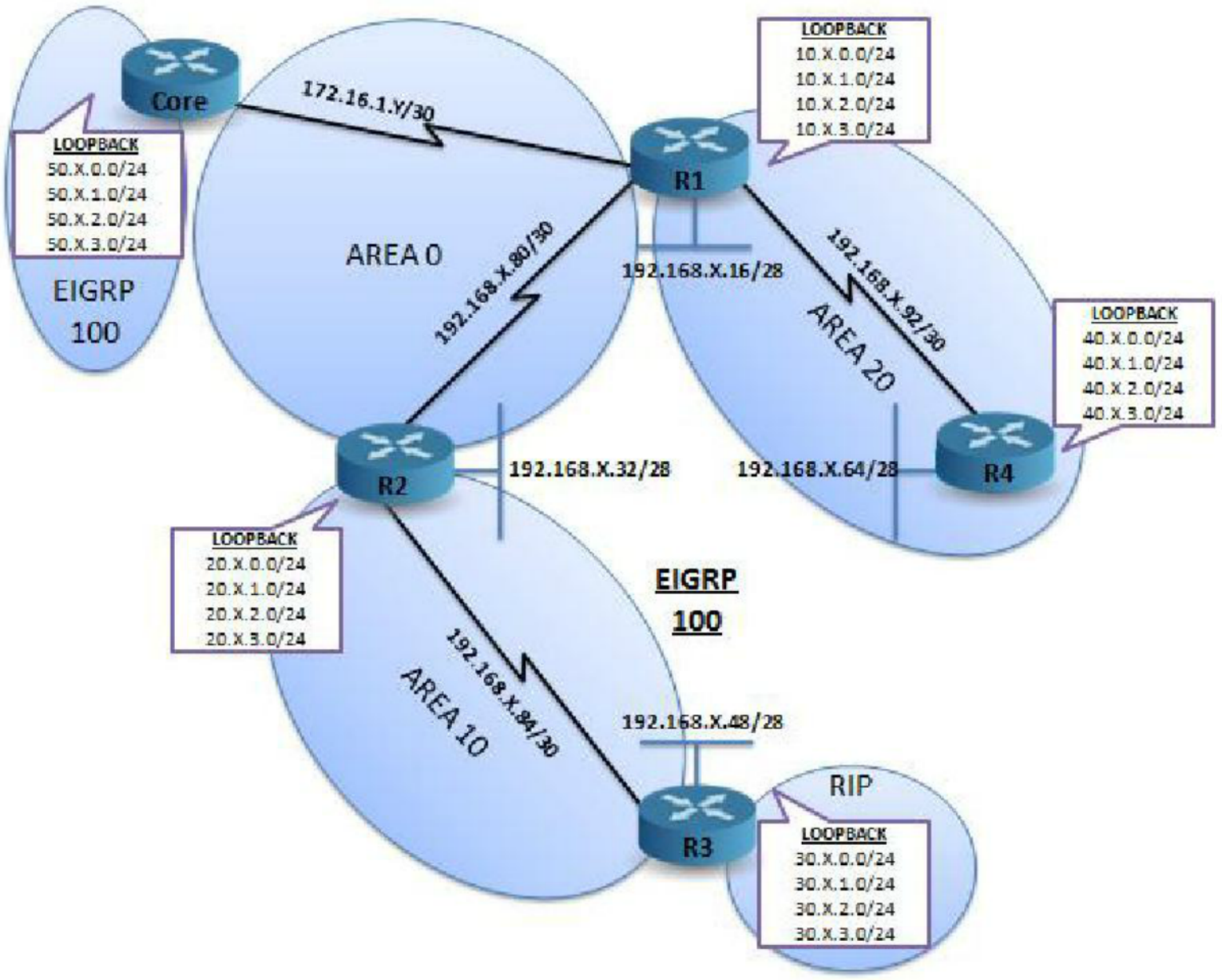
Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	32	0x80000001	0x00622E	0

LAB 15: OSPF TOTALLY NSSA

OBJECTIVE:

To configure and verify Totally NSSA AREA in OSPF

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in Multi Area OSPF as per given topology.
4) Verify Tables in OSPF.
5) Configure Area 10 as Totally NSSA.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers as did in Multi Area OSPF lab

4) Before making AREA 10 as Totally NSSA

   R3#show ip ospf database

   R3#show ip ospf database

OSPF Router with ID (30.1.3.1) (Process ID 100)

Router Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
20.1.3.1	20.1.3.1	802	0x80000006	0x00C344	6
30.1.3.1	30.1.3.1	760	0x80000005	0x007290	2

Summary Net Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
10.1.1.1	20.1.3.1	542	0x80000003	0x00B152
10.1.2.1	20.1.3.1	542	0x80000003	0x00A65C
10.1.3.1	20.1.3.1	542	0x80000003	0x009B66
40.1.0.0	20.1.3.1	131	0x80000001	0x00D10B
172.16.1.0	20.1.3.1	542	0x80000003	0x003DD6
172.16.1.3	20.1.3.1	542	0x80000003	0x00AA59
192.168.1.16	20.1.3.1	542	0x80000003	0x009D08
192.168.1.64	20.1.3.1	131	0x80000001	0x005D0A
192.168.1.80	20.1.3.1	1066	0x80000003	0x005901
192.168.1.88	20.1.3.1	131	0x80000001	0x0048EB
192.168.1.92	20.1.3.1	542	0x80000003	0x007EBF

Summary ASB Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
40.1.3.1	20.1.3.1	542	0x80000003	0x007E25

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	508	0x80000003	0x00FC5C	0
50.1.0.0	40.1.3.1	162	0x8000031F	0x006EB3	0

5) Configure AREA 10 as Totally NSSA

   R2(config)# router ospf 100
   R2(config-router)# area 20 nssa no-summary

   R3(config)# router ospf 100
   R3(config-router)# area 20 nssa

VERIFICATION:

➔ **After making the area 10 as Totally NSSA**

R3#show ip ospf database

OSPF Router with ID (30.1.3.1) (Process ID 100)

Router Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
20.1.3.1	20.1.3.1	16	0x8000000B	0x006595	6
30.1.3.1	30.1.3.1	136	0x80000007	0x0014E6	2

Summary Net Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
0.0.0.0	20.1.3.1	21	0x80000001	0x0061BB

Type-7 AS External Link States (Area 10)

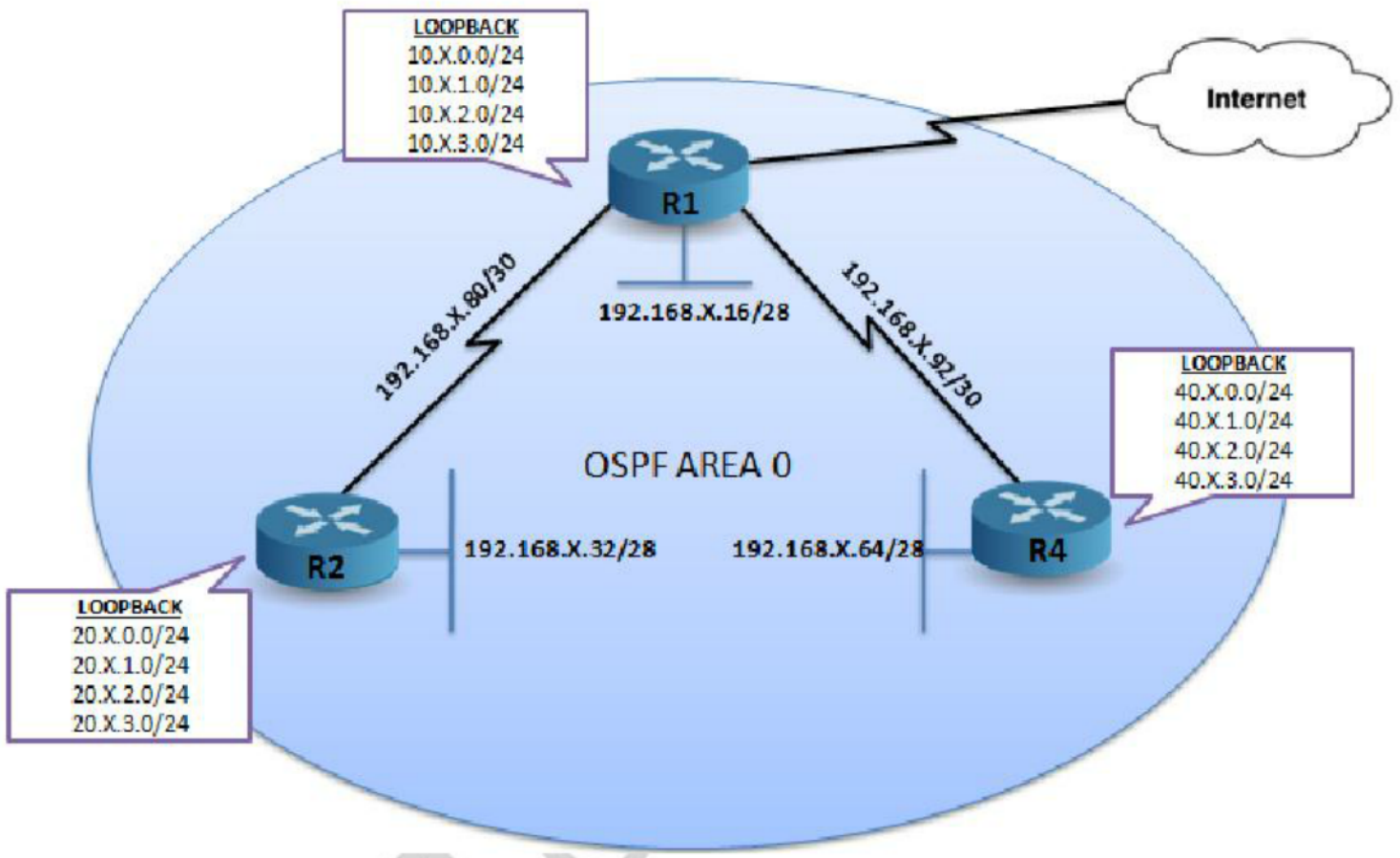
Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	15	0x80000002	0x00602F	0

LAB 16: DEFAULT ROUTE IN OSPF

OBJECTIVE:

To configure the OSPF process to advertise a default route

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in OSPF as per given topology.
4) Verify the functionality of **Default-information originate** command.

STEPS:

1) Verify the interface status by using **Show i interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers

   R1 (config)#router ospf 100
   R1 (config-router)# network 0.0.0.0 0.0.0.0 area 0

R2 (config)#router ospf 100
R2 (config-router)#network 0.0.0.0 0.0.0.0 area 0
R4(config)#router ospf 100
R4(config-router)# network 0.0.0.0 0.0.0.0 area 0

➔ **Verify the routing table before giving the Default-Information Originate command**

R2# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is 192.168.1.81 to network 0.0.0.0
     10.0.0.0/32 is subnetted, 3 subnets
O       10.1.1.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
O       10.1.2.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
O       10.1.3.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
     20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     40.0.0.0/32 is subnetted, 4 subnets
O       40.1.0.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O       40.1.1.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O       40.1.2.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O       40.1.3.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
     172.16.0.0/24 is subnetted, 1 subnets
O       172.16.1.0 [110/845] via 192.168.1.81, 00:07:18, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O       192.168.1.16/28 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
O       192.168.1.64/28 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
O       192.168.1.88/30 [110/2343] via 192.168.1.81, 00:07:18, Serial0/0/1
O       192.168.1.92/30 [110/1562] via 192.168.1.81, 00:07:18, Serial0/0/1
```

4) Configure Static Default route on the router that is connected to Internet

R1(config)# ip route 0.0.0.0 0.0.0.0 serial 0/1/1

5) Let the OSPF process advertise this default route to other routers.

R1(config)# router ospf 1
R1(config-router)# default-information originate

VERIFICATION:

➔ **After Default-Information Originate**

R2# show ip route

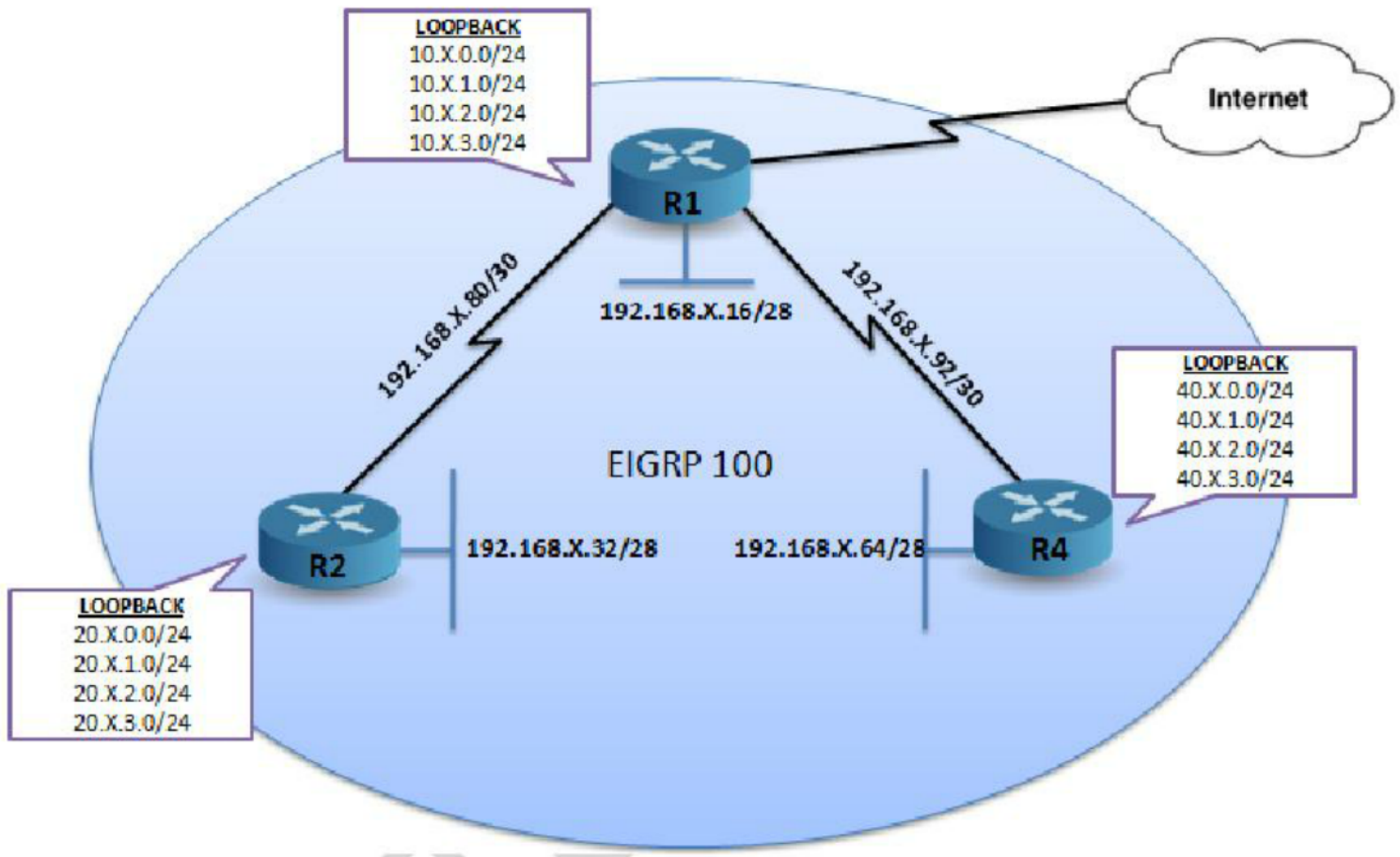
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is 192.168.1.81 to network 0.0.0.0
O*E2  0.0.0.0/0 [110/1] via 192.168.1.81, 00:00:25, Serial0/0/1
      10.0.0.0/32 is subnetted, 3 subnets
O        10.1.1.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
O        10.1.2.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
O        10.1.3.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
      20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C        20.1.0.0/24 is directly connected, Loopback0
L        20.1.0.1/32 is directly connected, Loopback0
C        20.1.1.0/24 is directly connected, Loopback1
L        20.1.1.1/32 is directly connected, Loopback1
C        20.1.3.0/24 is directly connected, Loopback3
L        20.1.3.1/32 is directly connected, Loopback3
      40.0.0.0/32 is subnetted, 4 subnets
O        40.1.0.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O        40.1.1.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O        40.1.2.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O        40.1.3.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
      172.16.0.0/24 is subnetted, 1 subnets
O        172.16.1.0 [110/845] via 192.168.1.81, 00:07:18, Serial0/0/1
      192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O        192.168.1.16/28 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
C        192.168.1.32/28 is directly connected, FastEthernet0/0
L        192.168.1.33/32 is directly connected, FastEthernet0/0
O        192.168.1.64/28 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
C        192.168.1.80/30 is directly connected, Serial0/0/1
L        192.168.1.82/32 is directly connected, Serial0/0/1
C        192.168.1.84/30 is directly connected, Serial0/0/0
L        192.168.1.85/32 is directly connected, Serial0/0/0
O        192.168.1.88/30 [110/2343] via 192.168.1.81, 00:07:18, Serial0/0/1
192.168.1.92/30 [110/1562] via 192.168.1.81, 00:07:18, Serial0/0/1
```

LAB 17: DEFAULT ROUTE IN EIGRP

OBJECTIVE:

To configure the EIGRP process to advertise a default route to other routers

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring EIGRP on all the routers.
3) Configure EIGRPon routers as per given topology.
4) Verify the functionality of Default route in EIGRP

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure EIGRP on all routers

   R1 (config)#router eigrp 100
   R1 (config-router)# network 0.0.0.0

R2 (config)#router eigrp 100
R2 (config-router)#network 0.0.0.0
R4(config)#router eigrp 100
R4(config-router)# network 0.0.0.0

➔ Verify the routing table before Configuring Static Default Route

R4# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
Gateway of last resort is not set
     10.0.0.0/24 is subnetted, 3 subnets
D       10.1.1.0 [90/20640000] via 192.168.1.94, 00:01:34, Serial0/0/0
D       10.1.2.0 [90/20640000] via 192.168.1.94, 00:01:34, Serial0/0/0
D       10.1.3.0 [90/20640000] via 192.168.1.94, 00:01:34, Serial0/0/0
     20.0.0.0/24 is subnetted, 3 subnets
D       20.1.0.0 [90/21152000] via 192.168.1.94, 00:01:26, Serial0/0/0
D       20.1.1.0 [90/21152000] via 192.168.1.94, 00:01:26, Serial0/0/0
D       20.1.3.0 [90/21152000] via 192.168.1.94, 00:01:26, Serial0/0/0
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     172.16.0.0/24 is subnetted, 1 subnets
D       172.16.1.0 [90/21024000] via 192.168.1.94, 00:01:34, Serial0/0/0
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
D       192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:01:34, Serial0/0/0
D       192.168.1.32/28 [90/21026560] via 192.168.1.94, 00:01:26, Serial0/0/0
C       192.168.1.64/28 is directly connected, FastEthernet0/0
L       192.168.1.65/32 is directly connected, FastEthernet0/0
D       192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:01:34, Serial0/0/0
D       192.168.1.84/30 [90/41536000] via 192.168.1.94, 00:01:26, Serial0/0/0
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

4) Configure Static Default route on the router that is connected to Internet

R1(config)# ip route 0.0.0.0 0.0.0.0 serial 0/1/1

VERIFICATION:

➔ **After configuring Static Default Route**

R4#show ip route

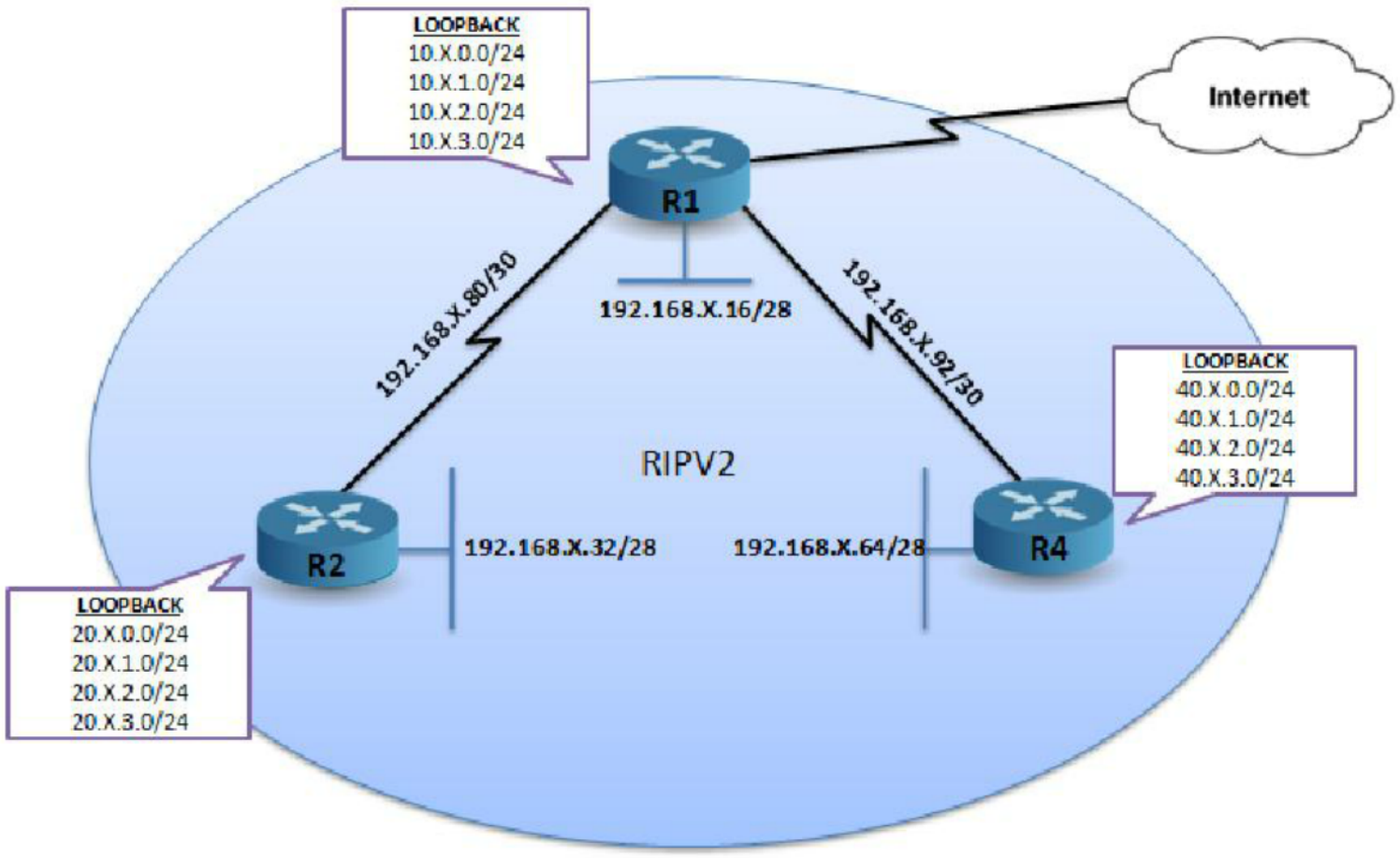
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 192.168.1.94 to network 0.0.0.0
D*    0.0.0.0/0 [90/21024000] via 192.168.1.94, 00:00:02, Serial0/0/0
      10.0.0.0/24 is subnetted, 3 subnets
D        10.1.1.0 [90/20640000] via 192.168.1.94, 00:01:46, Serial0/0/0
D        10.1.2.0 [90/20640000] via 192.168.1.94, 00:01:46, Serial0/0/0
D        10.1.3.0 [90/20640000] via 192.168.1.94, 00:01:46, Serial0/0/0
      20.0.0.0/24 is subnetted, 3 subnets
D        20.1.0.0 [90/21152000] via 192.168.1.94, 00:01:38, Serial0/0/0
D        20.1.1.0 [90/21152000] via 192.168.1.94, 00:01:38, Serial0/0/0
D        20.1.3.0 [90/21152000] via 192.168.1.94, 00:01:38, Serial0/0/0
      40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        40.1.0.0/24 is directly connected, Loopback0
L        40.1.0.1/32 is directly connected, Loopback0
C        40.1.1.0/24 is directly connected, Loopback1
L        40.1.1.1/32 is directly connected, Loopback1
C        40.1.2.0/24 is directly connected, Loopback2
L        40.1.2.1/32 is directly connected, Loopback2
C        40.1.3.0/24 is directly connected, Loopback3
L        40.1.3.1/32 is directly connected, Loopback3
      172.16.0.0/24 is subnetted, 1 subnets
D        172.16.1.0 [90/21024000] via 192.168.1.94, 00:01:46, Serial0/0/0
      192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
D        192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:01:46, Serial0/0/0
D        192.168.1.32/28 [90/21026560] via 192.168.1.94, 00:01:38, Serial0/0/0
C        192.168.1.64/28 is directly connected, FastEthernet0/0
L        192.168.1.65/32 is directly connected, FastEthernet0/0
D        192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:01:46, Serial0/0/0
D        192.168.1.84/30 [90/41536000] via 192.168.1.94, 00:01:38, Serial0/0/0
C        192.168.1.88/30 is directly connected, Serial0/0/1
L        192.168.1.90/32 is directly connected, Serial0/0/1
C        192.168.1.92/30 is directly connected, Serial0/0/0
L        192.168.1.93/32 is directly connected, Serial0/0/0
```

LAB 18: DEFAULT ROUTE IN RIP

OBJECTIVE:

To configure the RIP process to advertise a default route to its neighboring routers.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring RIP on all the routers.
3) Configure Routers in RIP as per given topology.
4) Advertise adefault route via RIP

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure RIP on all routers

   R1 (config)#router rip

R1 (config-router)# network 0.0.0.0
R1(config-router)# version 2
R1(config-router)#no auto-summary
R2 (config)#router rip
R2 (config-router)#network 0.0.0.0
R2(config-router)# version 2
R2(config-router)#no auto-summary
R4(config)#router rip
R4(config-router)# network 0.0.0.0
R4(config-router)# version 2
R4(config-router)#no auto-summary

4) Configure Static Default route on the router that is connected to Internet

R1(config)# ip route 0.0.0.0 0.0.0.0 serial 0/1/1

5) Configure Default-Information originate on R1 router.

R1(config)# router rip
R1(config-router)# default-information originate

VERIFICATION:

➔ **Before Configuring default-information originate command**

R4# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
    10.0.0.0/24 is subnetted, 3 subnets
R      10.1.1.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
R      10.1.2.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
R      10.1.3.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
    20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C      20.1.0.0/24 is directly connected, Loopback0
L      20.1.0.1/32 is directly connected, Loopback0
C      20.1.1.0/24 is directly connected, Loopback1
L      20.1.1.1/32 is directly connected, Loopback1
C      20.1.3.0/24 is directly connected, Loopback3
L      20.1.3.1/32 is directly connected, Loopback3
    40.0.0.0/24 is subnetted, 4 subnets
R      40.1.0.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R      40.1.1.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R      40.1.2.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R      40.1.3.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
    172.16.0.0/24 is subnetted, 1 subnets
R      172.16.1.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
    192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
R      192.168.1.16/28 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
```

```
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
R       192.168.1.64/28 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
R       192.168.1.88/30 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R       192.168.1.92/30 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
```

➔ **After Configuring default-information originate command**

R4# show ip route

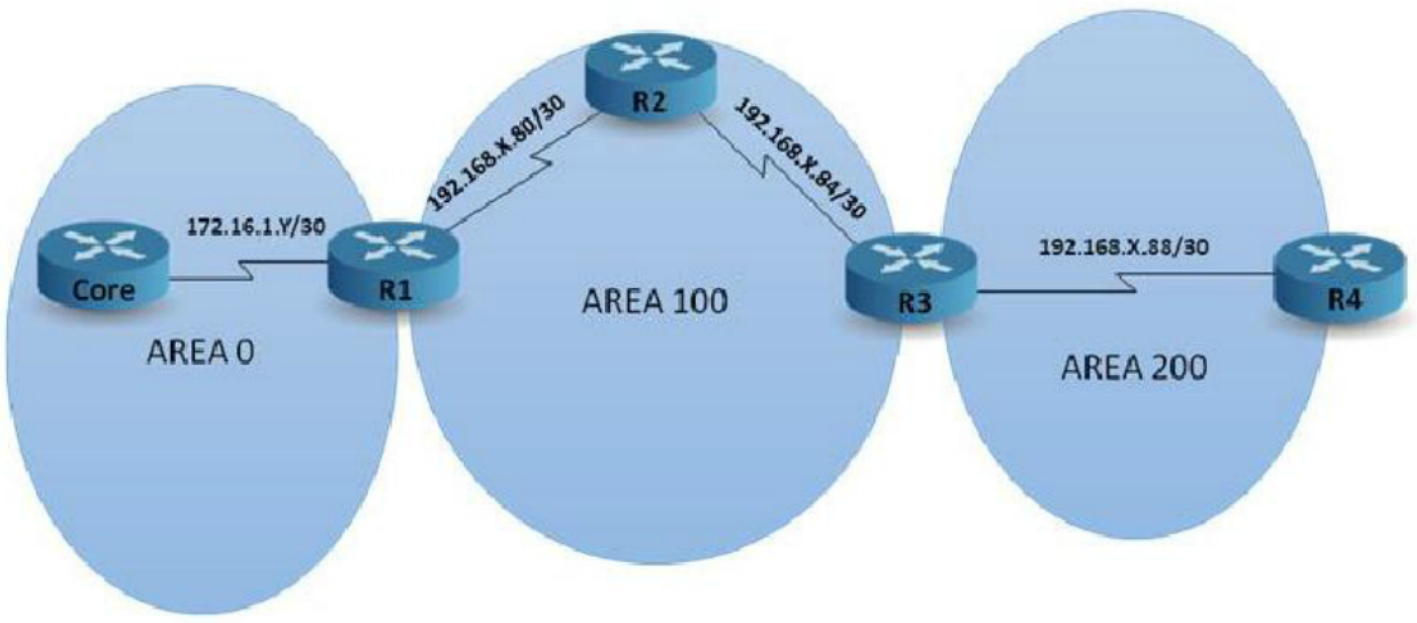
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is 192.168.1.81 to network 0.0.0.0
      R*    0.0.0.0/0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
     10.0.0.0/24 is subnetted, 3 subnets
R       10.1.1.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
R       10.1.2.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
R       10.1.3.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
     20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     40.0.0.0/24 is subnetted, 4 subnets
R       40.1.0.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R       40.1.1.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R       40.1.2.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R       40.1.3.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
   172.16.0.0/24 is subnetted, 1 subnets
R       172.16.1.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
R       192.168.1.16/28 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
R       192.168.1.64/28 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
R       192.168.1.88/30 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R       192.168.1.92/30 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
```

LAB 19: OSPF VIRTUAL LINK

OBJECTIVE:

To configure anOSPF virtual link to connect disjointed OSPF areas to the backbone area

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring OSPF on all the routers.
3) Configure Routers in OSPF as per given topology.
4) Verify the functionality of Virtual Link

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure OSPF on all routers as per topology

   Core(conf)#router ospf 100
   Core(config-router)#router-id 1.1.1.1
   Core(config-router)#network 50.1.0.0 0.0.255.255 area 0
   Core(config-router)#network 172.16.0.0 0.0.255.255 area 100
   R1(config)# router ospf 100
   R1(config-router)#router-id 2.2.2.2

R1(config-router)#network 172.16.0.0 0.0.255.255 area 0
R1(config-router)#network 192.168.X.80 0.0.0.3 area 100
R2(config)# router ospf 100
R2(config-router)#router-id 3.3.3.3
R2(config-router)# network 192.168.X.80 0.0.0.3 area 100
R2(Config-router)#network 192.168.X.84 0.0.0.3 area 100
R3(config)# router ospf 100
R3(config-router)#router-id 4.4.4.4
R3(Config-router)#network 192.168.X.88 0.0.0.3 area 100
R3(Config-router)#network 192.168.X.92 0.0.0.3 area 200
R4(config)# router ospf 100
R4(config-router)#router-id 5.5.5.5
R4(Config-router)#network 192.168.X.92 0.0.0.3 area 200

➔ **Before Configuring Virtual Link**

R4# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
   ia - IS-IS inter area, * - candidate default, U - per-user static route
   o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
Gateway of last resort is not set
      40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        40.1.0.0/24 is directly connected, Loopback0
L        40.1.0.1/32 is directly connected, Loopback0
C        40.1.1.0/24 is directly connected, Loopback1
L        40.1.1.1/32 is directly connected, Loopback1
C        40.1.2.0/24 is directly connected, Loopback2
L        40.1.2.1/32 is directly connected, Loopback2
C        40.1.3.0/24 is directly connected, Loopback3
L        40.1.3.1/32 is directly connected, Loopback3
      192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C        192.168.1.64/28 is directly connected, FastEthernet0/0
L        192.168.1.65/32 is directly connected, FastEthernet0/0
C        192.168.1.88/30 is directly connected, Serial0/0/1
L        192.168.1.90/32 is directly connected, Serial0/0/1
C        192.168.1.92/30 is directly connected, Serial0/0/0
L        192.168.1.93/32 is directly connected, Serial0/0/0
```

4) Configure Virtual link on R1 and R3 routers.

R1(config)#router ospf 100
R1(config-router)# area 100 virtual-link 4.4.4.4
R3(config)#router ospf 100
R3(config-router)# area 100 virtual-link 1.1.1.1

VERIFICATION:

➔ **After Configuring Virtual Link**

R4#show ip route

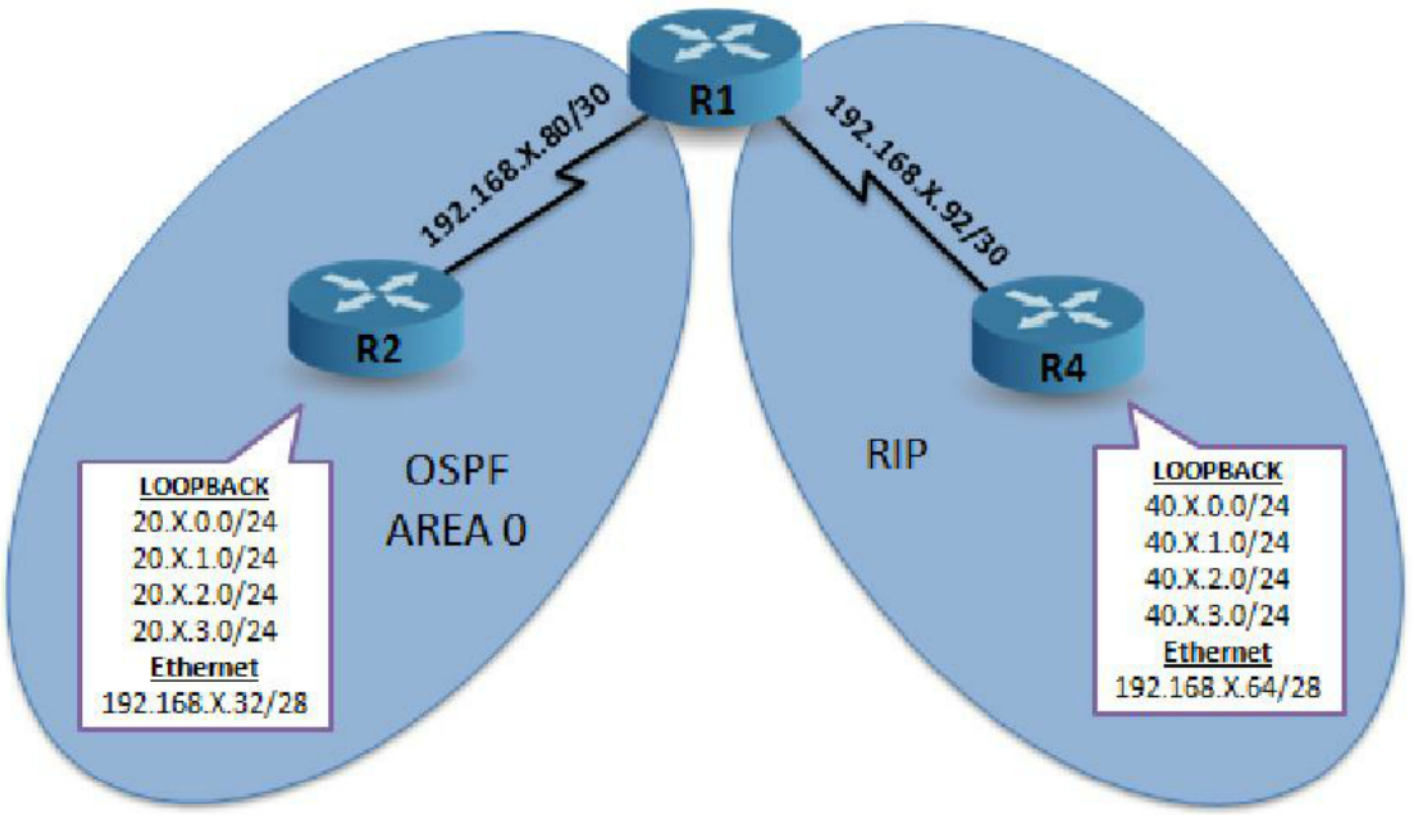
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static rout
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
Gateway of last resort is not set
20.0.0.0/32 is subnetted, 3 subnets
O IA    20.1.0.1 [110/2344] via 192.168.1.89, 00:00:15, Serial0/0/1
O IA    20.1.1.1 [110/2344] via 192.168.1.89, 00:00:15, Serial0/0/1
O IA    20.1.3.1 [110/2344] via 192.168.1.89, 00:00:15, Serial0/0/1
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     50.0.0.0/32 is subnetted, 4 subnets
O IA    50.1.0.1 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1
O IA    50.1.1.1 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1
O IA    50.1.2.1 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1
O IA    50.1.3.1 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
O IA    172.16.1.0/24 [110/3188] via 192.168.1.89, 00:00:11, Serial0/0/1
O IA    172.16.1.0/30 [110/3969] via 192.168.1.89, 00:00:11, Serial0/0/1
O IA  192.168.0.0/24 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 9 subnets, 3 masks
O IA    192.168.1.32/28 [110/2344] via 192.168.1.89, 00:00:15, Serial0/0/1
C       192.168.1.64/28 is directly connected, FastEthernet0/0
L       192.168.1.65/32 is directly connected, FastEthernet0/0
O IA    192.168.1.80/30 [110/3124] via 192.168.1.89, 00:00:15, Serial0/0/1
O IA    192.168.1.84/30 [110/2343] via 192.168.1.89, 00:00:15, Serial0/0/1
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

LAB 20: REDISTRIBUTION BETWEEN RIP and OSPF

OBJECTIVE:

To configure and verify Route Redistribution between RIP and OSPF

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Configure OSPF and RIP on routers as per given topology.
3) Configure Redistribution.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure RIP between R1 and R4 routers

   R1(config)#router rip
   R1(config-router)#version 2
   R1(config-router)#network 192.168.X.92
   R1(config-router)# no auto-summary
   R4(Config)# router rip

R4(Config-router)# network 40.0.0.0
R4(Config-router)# network 192.168.X.0
R4(config-router)# no auto-summary

4) Configure OSPF AREA 0 in R1 and R2 routers.

R1(config)# router ospf 100
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
R2 (config)#router ospf 100
R2(config-router)#network 20.X.0.0 0.0.255.255 area 0
R2(config-router) #network 192.168.X.32 0.0.0.15 area 0
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0

5) Configure Route Redistribution on R1 router

R1(config)#router rip
R1(config-router)#redistribute ospf 100 metric 5 subnets
R1(config)#router ospf 100
R1(config-router)# redistribute rip subnets metric 10

VERIFICATION:

➔ **Before Configuring Redistribution**

R2# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0

R4# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2

```
        i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
        ia - IS-IS inter area, * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
        + - replicated route, % - next hop override
Gateway of last resort is not set
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
R       192.168.1.16/28 [120/1] via 192.168.1.94, 00:00:09, Serial0/0/0
C       192.168.1.64/28 is directly connected, FastEthernet0/0
L       192.168.1.65/32 is directly connected, FastEthernet0/0
R       192.168.1.80/30 [120/1] via 192.168.1.94, 00:00:09, Serial0/0/0
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

➔ **After Configuring Redistribution from RIP into OSPF**

R2 # show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
     20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     40.0.0.0/24 is subnetted, 4 subnets
O E2    40.1.0.0 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
O E2    40.1.1.0 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
O E2    40.1.2.0 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
O E2    40.1.3.0 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O E2    192.168.1.16/28 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
O E2    192.168.1.64/28 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
```

```
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
O E2    192.168.1.88/30 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
O E2    192.168.1.92/30 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
```

➔ **After Configuring Redistribution from OSPF into RIP**

R4# show ip route

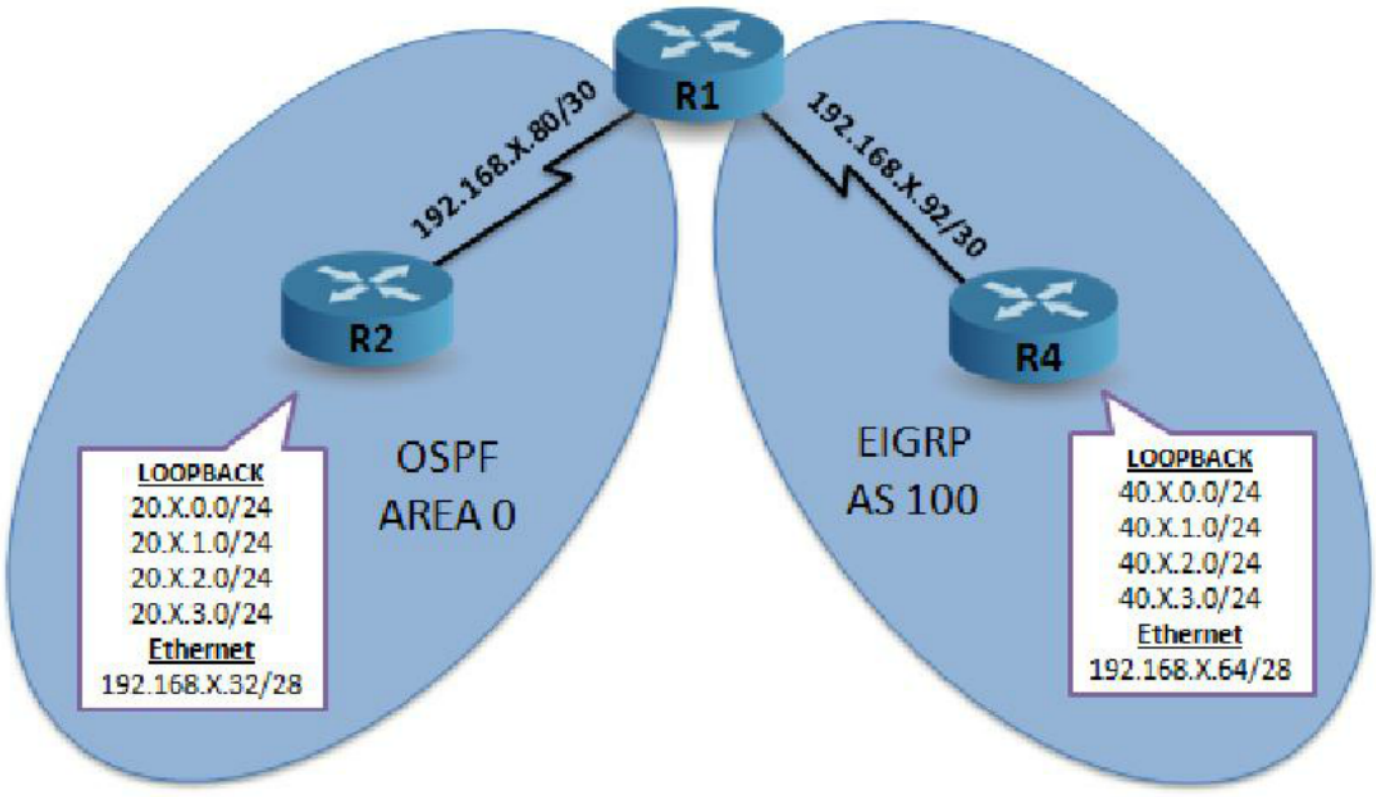
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
Gateway of last resort is not set
     20.0.0.0/32 is subnetted, 3 subnets
R       20.1.0.1 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
R       20.1.1.1 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
R       20.1.3.1 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
R       192.168.1.16/28 [120/1] via 192.168.1.94, 00:00:01, Serial0/0/0
R       192.168.1.32/28 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
C       192.168.1.64/28 is directly connected, FastEthernet0/0
L       192.168.1.65/32 is directly connected, FastEthernet0/0
R       192.168.1.80/30 [120/1] via 192.168.1.94, 00:00:01, Serial0/0/0
R       192.168.1.84/30 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

LAB 21: REDISTRIBUTION BETWEEN EIGRP AND OSPF

OBJECTIVE:

To configure and verify Route Redistribution between EIGRP and OSPF

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Configure OSPF and EIGRP on routers as per given topology.
3) Configure Redistribution.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure EIGRP between R1 and R4 routers

   R1(config)#router eigrp 100
   R1(config-router)#network 192.168.X.92
   R1(config-router)# no auto-summary
   R4(Config)# router eigrp 100
   R4(Config-router)# network 40.0.0.0
   R4(Config-router)# network 192.168.X.0
   R4(config-router)# no auto-summary

4) Configure OSPF AREA 0 in R1 and R2 routers.

R1(config)# router ospf 100
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
R2 (config)#router ospf 100
R2(config-router)#network 20.X.0.0 0.0.255.255 area 0
R2(config-router) #network 192.168.X.32 0.0.0.15 area 0
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0

5) Configure Route Redistribution on R1 router

R1(config)#router eigrp 100
R1(config-router)#redistribute ospf 100 metric 1000 1000 100 100 1500
R1(config)#router ospf 100
R1(config-router)# redistribute eigrp 100 subnets

VERIFICATION:

➔ **Before Configuring Redistribution**

R2# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0

R4# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

```
       + - replicated route, % - next hop override
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
D       192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:02:05, Serial0/0/0
D       192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:02:05, Serial0/0/0
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

➔ **After Configuring Redistribution from EIGRP into OSPF**

R2 # show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
     20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     40.0.0.0/24 is subnetted, 4 subnets
O E2    40.1.0.0 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
O E2    40.1.1.0 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
O E2    40.1.2.0 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
O E2    40.1.3.0 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 9 subnets, 3 masks
O E2    192.168.1.16/28 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
O E2    192.168.1.88/30 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
O E2    192.168.1.92/30 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
```

➔ **After Configuring Redistribution from OSPF into EIGRP**

R4# show ip route

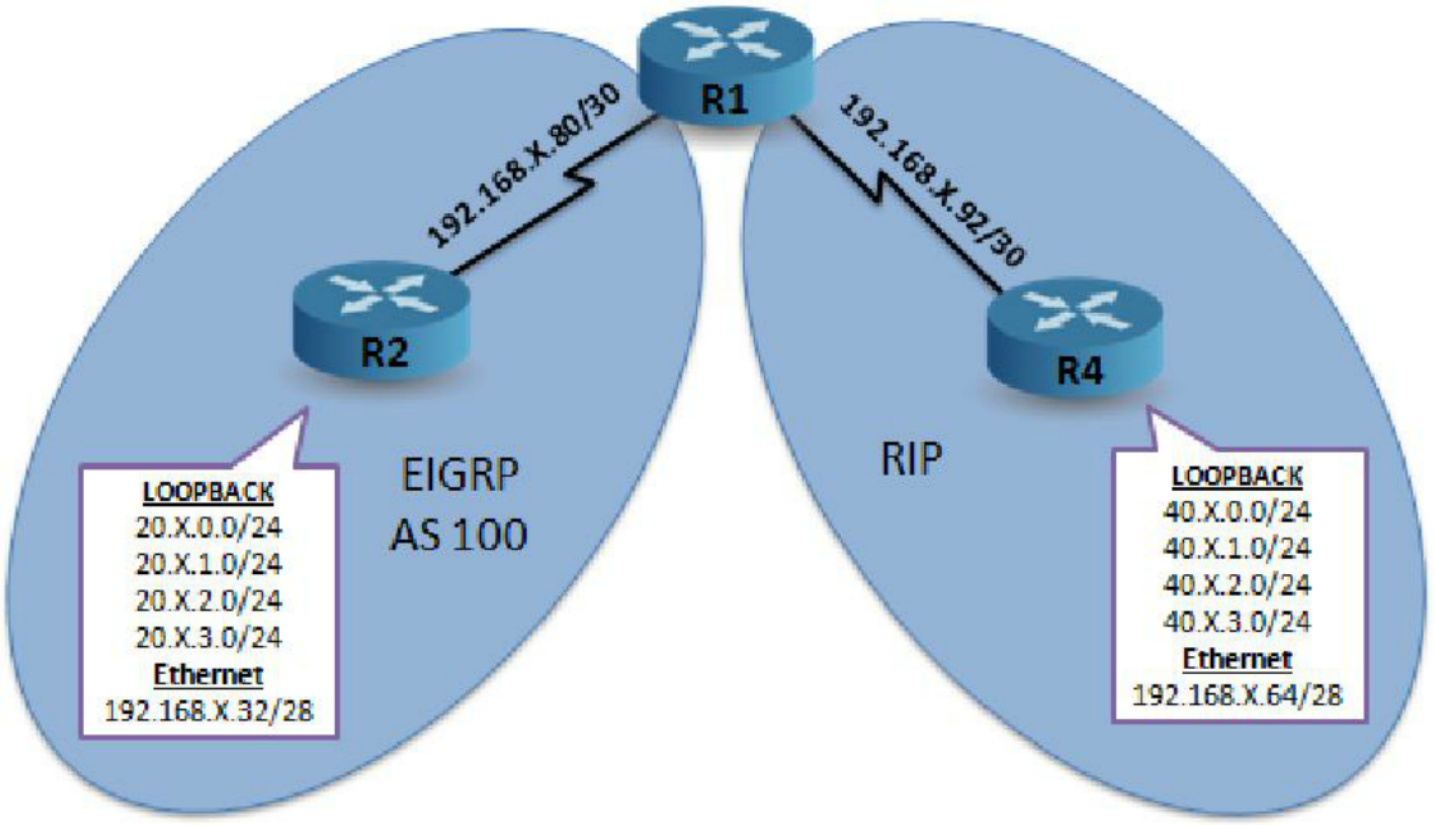
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
Gateway of last resort is not set
     20.0.0.0/32 is subnetted, 3 subnets
D EX    20.1.0.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D EX    20.1.1.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D EX    20.1.3.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
D       192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:03:01, Serial0/0/0
D EX    192.168.1.32/28
        [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D       192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:03:01, Serial0/0/0
D EX    192.168.1.84/30   [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

LAB 22: REDISTRIBUTION BETWEEN RIP AND EIGRP

OBJECTIVE:

To configure and verify Route Redistribution between EIGRP and RIP

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Configure Routers in RIP and EIGRP as per given topology.
3) Configure Redistribution.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure EIGRP between R1 and R4 routers

   R1(config)#router eigrp 100
   R1(config-router)#network 192.168.X.92
   R1(config-router)# no auto-summary

R4(Config)# router eigrp 100
R4(Config-router)# network 40.0.0.0
R4(Config-router)# network 192.168.X.0
R4(config-router)# no auto-summary

4) Configure RIP in R1 and R2 routers.

R1(config)# router RIP
R1 (config-router)# network 192.168.X.80
R1 (config-router)#version 2
R1 (config-router)#no auto-summary
R2 (config)#router rip
R2(config-router)#network 0.0.0.0
R2 (config-router)#version 2
R2 (config-router)#no auto-summary

5) Configure Route Redistribution on R1 router
R1(config)#router eigrp 100
R1(config-router)#redistribute rip metric 1000 1000 100 100 1500
R1(config)#router rip
R1(config-router)# redistribute eigrp 100 metric 5

VERIFICATION:

➔ **Before Configuring Redistribution**

R2# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route

Gateway of last resort is not set
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
    192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
```

R4# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
D       192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:02:05, Serial0/0/0
D       192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:02:05, Serial0/0/0
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

➔ **After Configuring Redistribution from EIGRP into RIP**

R2 # show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
     20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
```

```
     40.0.0.0/24 is subnetted, 4 subnets
R       40.1.0.0 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
R       40.1.1.0 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
R       40.1.2.0 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
R       40.1.3.0 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 9 subnets, 3 masks
R       192.168.1.16/28 [120/1] via 192.168.1.81, 00:00:20, Serial0/0/1
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
R       192.168.1.88/30 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
R       192.168.1.92/30 [120/1] via 192.168.1.81, 00:00:20, Serial0/0/1
```

➔ **After Configuring Redistribution from RIP into EIGRP**

R4# show ip route

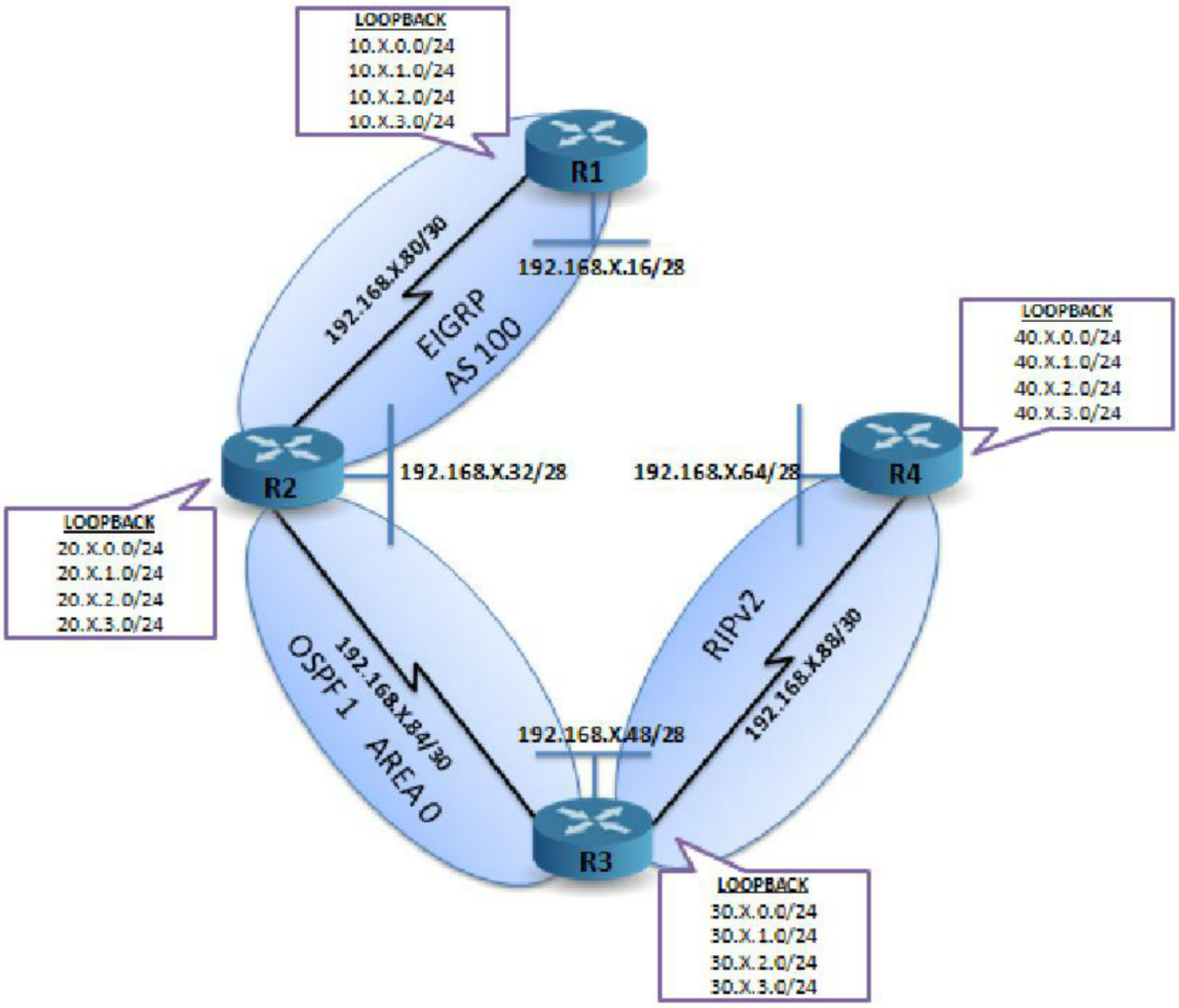
```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
Gateway of last resort is not set
     20.0.0.0/32 is subnetted, 3 subnets
D EX    20.1.0.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D EX    20.1.1.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D EX    20.1.3.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
D       192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:03:01, Serial0/0/0
D EX    192.168.1.32/28 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D       192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:03:01, Serial0/0/0
D EX    192.168.1.84/30[170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

LAB 23: ADVANCED REDISTRIBUTION

OBJECTIVE:

To configure and verify Route Redistribution between EIGRP, OSPF and RIP

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Configure RIP,EIGRP and OSPF on routers as per given topology.
3) Configure Redistribution.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure EIGRP between R1 and R2 routers

```
R1(config)# router eigrp 100
R1(config-router)#network 10.0.0.0  0.0.255.255
R1(config-router)#network 192.168.X.16 0.0.0.15
R1(config-router)#network 192.168.X.80 0.0.0.3
R1(config-router)#no auto-summary
R1(config-router)#exit
R2(config)# router eigrp 100
R2(config-router)# network 192.168.X.80 0.0.0.3
R2(config-router)#no auto-summary
R2(config-router)#exit
```

4) Configure OSPF AREA 0 between R2 and R3 routers.

```
R2(config)# router ospf 1
R2(config-router)#network 192.168.X.84 0.0.0.3 area 0
R2(config-router)#network 192.168.X.32 0.0.0.15 area 0
R2(config-router)#network 20.0.0.0 0.0.255.255 area 0
R2(config-router)#exit
R3(config)# router ospf 1
R3(config-router)#network 192.168.X.84 0.0.0.3 area 0
R3(config-router)#network 30.0.0.0 0.0.255.255 area 0
R3(config-router)#exit
```

5) Configure RIPV2 between R3 and R4 routers.

```
R3(config)# router rip
R3(config-router)#version 2
R3(config-router)#network 192.168.X.0
R3(config-router)#no auto-summary
R3(config-router)#exit
R4(config)# router rip
R4(config-router)#version 2
R4(config-router)#network 192.168.X.0
R4(config-router)#network 40.0.0.0
R4(config-router)#no auto-summary
R4(config-router)#exit
```

6) Configure Redistribution on R2 router to redistribute from EIGRP to OSPF and vice versa.

```
R2(config)# router eigrp 100
R2(config-router)#redistribute ospf 1 metric 1500 2000 255 1 1500
R2(config)# router ospf 1
R2(config-router)#redistribute eigrp 100 subnets
```

7) Configure Redistribution on R3 router to redistribute from OSPF to RIP and vice versa.

R3(config)# router ospf 1
R3(config-router)#redistribute rip subnets
R3(config)# router rip
R3(config-router)#redistribute ospf 1 metric 5

VERIFICATION:

➔ **Before Configuring Redistribution**

R4#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
Gateway of last resort is not set

30.0.0.0/24 is subnetted, 1 subnets
R 30.1.3.0 [120/1] via 192.168.1.89, 00:00:12, Serial0/0/1
40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
R 192.168.1.48/28 [120/1] via 192.168.1.89, 00:00:12, Serial0/0/1
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
R 192.168.1.84/30 [120/1] via 192.168.1.89, 00:00:12, Serial0/0/1
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0

➔ **After Configuring Redistribution**

R4#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route

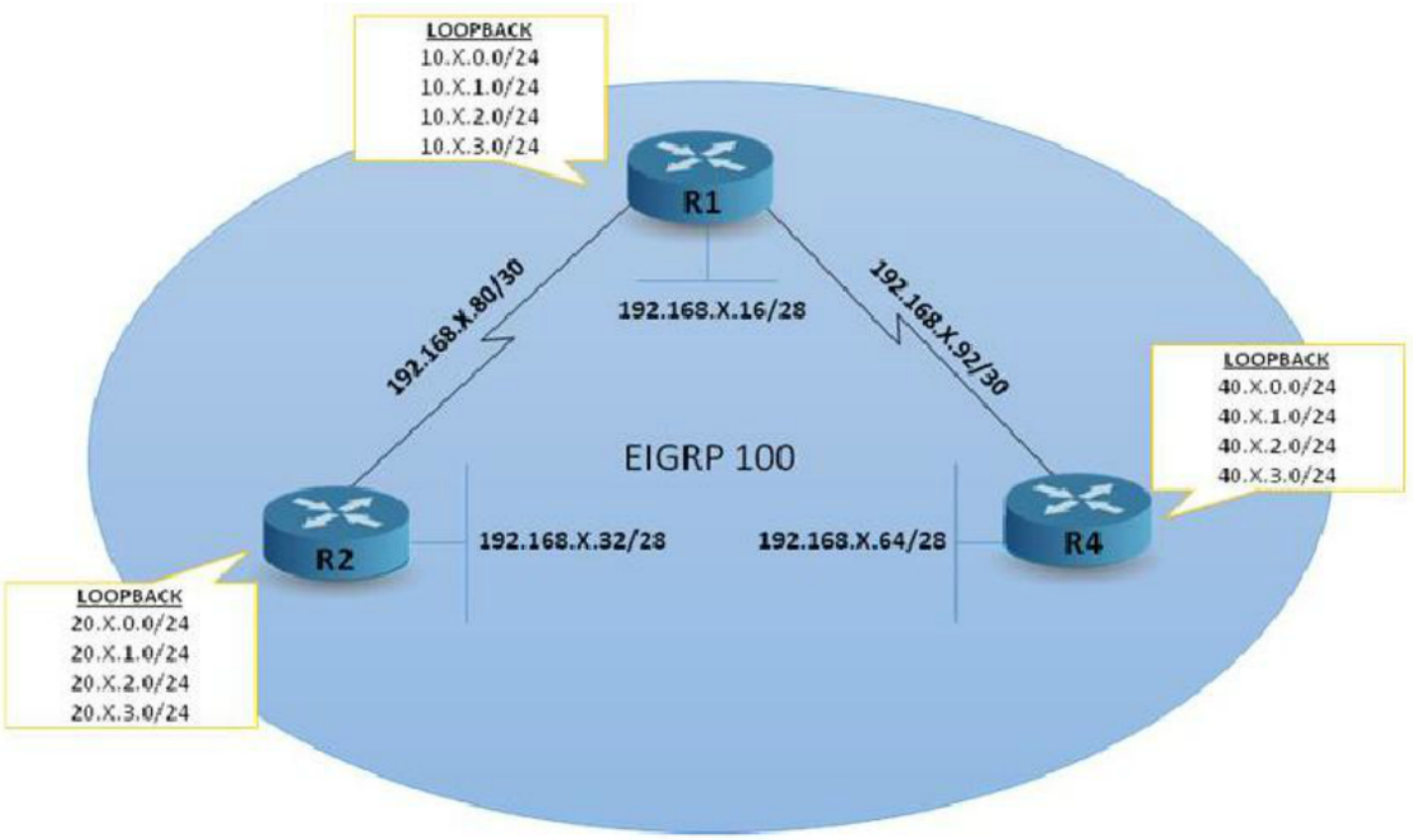
```
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      + - replicated route, % - next hop override
Gateway of last resort is not set
     10.0.0.0/24 is subnetted, 3 subnets
R       10.1.1.0 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
R       10.1.2.0 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
R       10.1.3.0 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
     20.0.0.0/32 is subnetted, 3 subnets
R       20.1.0.1 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
R       20.1.1.1 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
R       20.1.3.1 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
     30.0.0.0/24 is subnetted, 1 subnets
R       30.1.3.0 [120/1] via 192.168.1.89, 00:00:09, Serial0/0/1
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
R       192.168.1.16/28 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
R       192.168.1.32/28 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
R       192.168.1.48/28 [120/1] via 192.168.1.89, 00:00:09, Serial0/0/1
C       192.168.1.64/28 is directly connected, FastEthernet0/0
L       192.168.1.65/32 is directly connected, FastEthernet0/0
R       192.168.1.80/30 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1
R       192.168.1.84/30 [120/1] via 192.168.1.89, 00:00:09, Serial0/0/1
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

LAB 24: DISTRIBUTE LISTS

OBJECTIVE:

To configure distribute-lists to control which networks are to be advertised to which router

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Configure EIGRP in all routers.
3) Configure Distribute-list to prevent the 20.0.0.0/24 network from being advertised to R4 router.
4) Verify the output in the routing table of R4 Router.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure EIGRP in all routers.

   R1 (config)#router eigrp 100
   R1 (config-router)# network 0.0.0.0
   R2 (config)#router eigrp 100
   R2 (config-router)#network 0.0.0.0

R4(config)#router eigrp 100
R4(config-router)# network 0.0.0.0

➔ **Before Configuring Distribute Lists**

R4# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override
Gateway of last resort is not set
20.0.0.0/24 is subnetted, 3 subnets
D 20.1.0.0 [90/21152000] via 192.168.1.94, 00:03:00, Serial0/0/0
D 20.1.1.0 [90/21152000] via 192.168.1.94, 00:03:00, Serial0/0/0
D 20.1.3.0 [90/21152000] via 192.168.1.94, 00:03:00, Serial0/0/0
40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0

4) Configure Access-list on R1 router to Identify Traffic

R1(config)# access-list 10 deny 20.1.0.0 0.0.255.255
R1(config)# access-list 10 permit any

5) Configure Distribute List on R1 router to stop the 20.0.0./24 network from being advertised to R4

R1(config)# router eigrp 100
R1(config-router)# distribute-list 10 out serial 0/1/0
VERIFICATION:
After Configuring Distribute Lists
R4# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

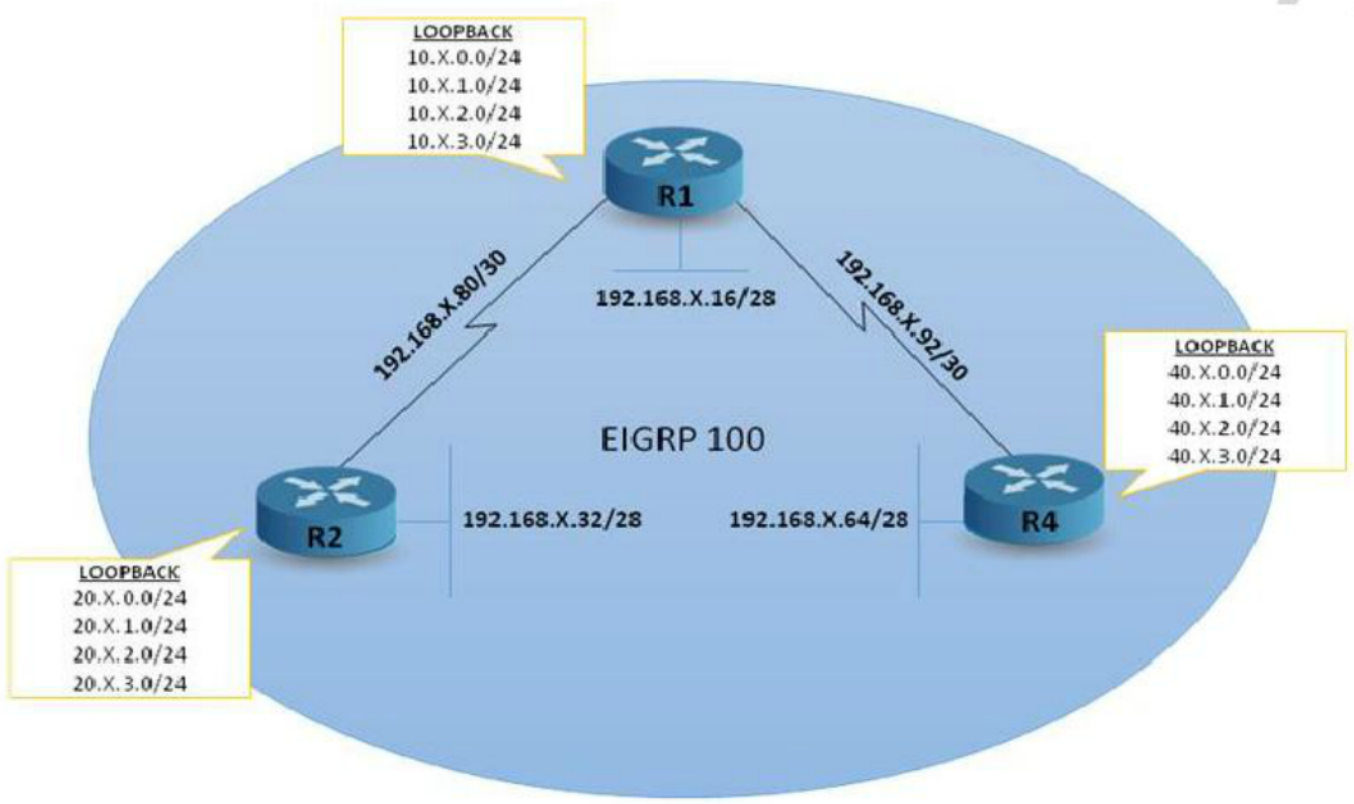
```
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      + - replicated route, % - next hop override
Gateway of last resort is not set
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C       192.168.1.64/28 is directly connected, FastEthernet0/0
L       192.168.1.65/32 is directly connected, FastEthernet0/0
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

LAB 25: PASSIVE INTERFACE

OBJECTIVE:

To configure passive interfaces so that hello packets are not sent on interfaces where theyare not required.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Configure EIGRP in all routers.
3) Configure and Verify Passive-Interface

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure EIGRP in all routers.

   R1 (config)#router eigrp 100
   R1 (config-router)# network 0.0.0.0
   R2 (config)#router eigrp 100
   R2 (config-router)#network 0.0.0.0

R4(config)#router eigrp 100
R4(config-router)# network 0.0.0.0

➔ **Before Configuring Passive Interface**

R4# debug eigrp packets hello

*Jul 23 06:04:26.687: EIGRP: Sending HELLO on Loopback0
*Jul 23 06:04:26.687: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0
*Jul 23 06:04:26.687: EIGRP: Received HELLO on Loopback0 nbr 40.1.0.1
*Jul 23 06:04:26.687: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 23 06:04:27.067: EIGRP: Sending HELLO on Loopback3
*Jul 23 06:04:27.067: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0
*Jul 23 06:04:27.067: EIGRP: Received HELLO on Loopback3 nbr 40.1.3.1
*Jul 23 06:04:27.067: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 23 06:04:27.619: EIGRP: Sending HELLO on FastEthernet0/0
*Jul 23 06:04:27.619: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0
*Jul 23 06:04:27.963: EIGRP: Sending HELLO on Serial0/0/0
*Jul 23 06:04:27.963: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0
*Jul 23 06:04:29.143: EIGRP: Sending HELLO on Serial0/0/1
*Jul 23 06:04:29.143: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0

4) Configure Passive-Interface on the interface that is connected to switch on all routers.

R4(config)# router eigrp 100
R4(config-router)# passive-interface fastethernet 0/0

VERIFICATION:

➔ **After Configuring Passive Interface**

R4#debug eigrp packets hello

(HELLO)

EIGRP Packet debugging is on
R4#
*Jul 23 06:04:49.051: EIGRP: Sending HELLO on Loopback1
*Jul 23 06:04:49.051: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0
*Jul 23 06:04:49.051: EIGRP: Received HELLO on Loopback1 nbr 40.1.1.1
*Jul 23 06:04:49.051: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 23 06:04:49.255: EIGRP: Sending HELLO on Loopback0
*Jul 23 06:04:49.255: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0
*Jul 23 06:04:49.255: EIGRP: Received HELLO on Loopback0 nbr 40.1.0.1
*Jul 23 06:04:49.255: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0

```
*Jul 23 06:04:50.203: EIGRP: Sending HELLO on Loopback3
*Jul 23 06:04:50.203:   AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0
*Jul 23 06:04:50.203: EIGRP: Received HELLO on Loopback3 nbr 40.1.3.1
*Jul 23 06:04:50.203:   AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 23 06:04:51.239: EIGRP: Sending HELLO on Serial0/0/1
*Jul 23 06:04:51.239:   AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u
n/rely 0/0
```

To Verify Which Interface is Passive-Interface

R4# show ip protocols

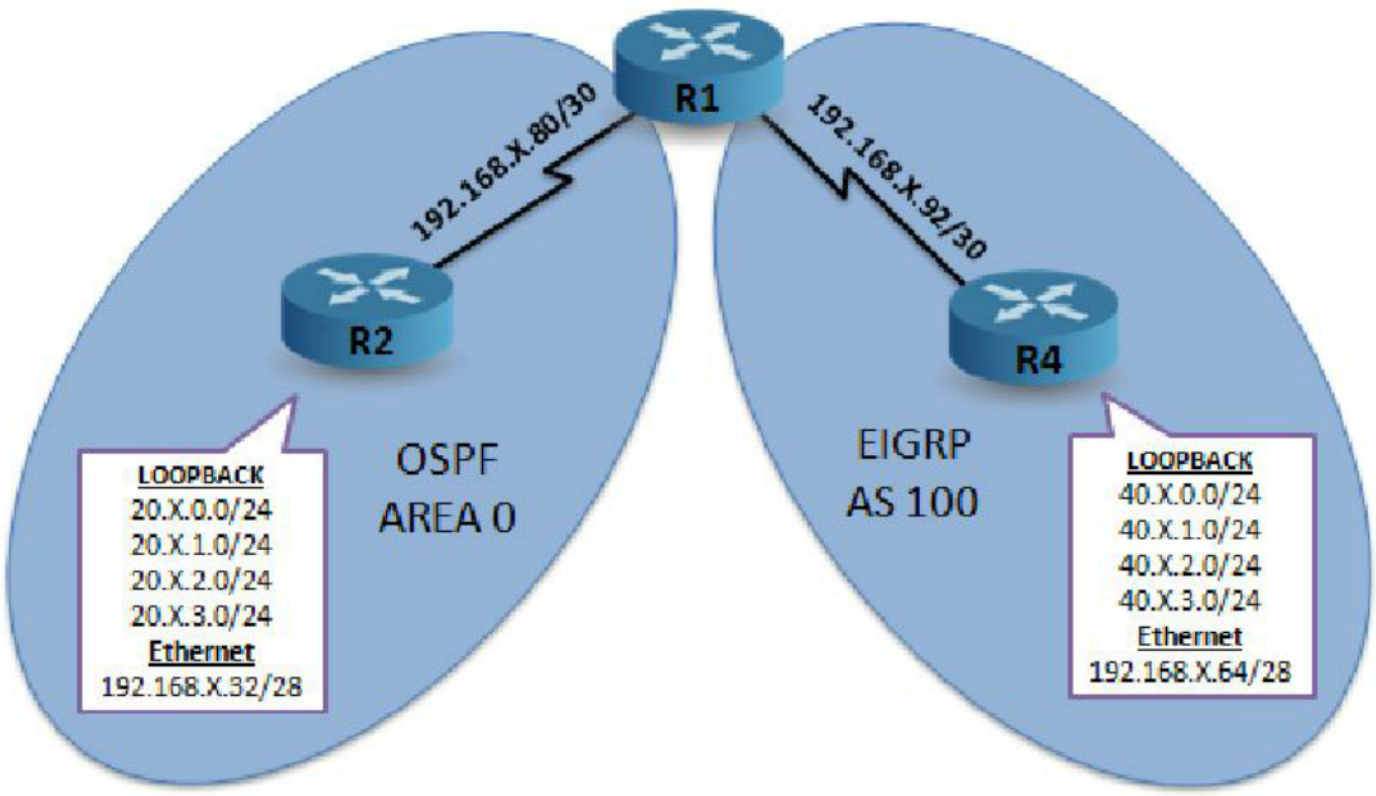
```
*** IP Routing is NSF aware ***
Routing Protocol is "eigrp 100"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP-IPv4 Protocol for AS(100)
    Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
    NSF-aware route hold timer is 240
    Router-ID: 40.1.3.1
    Topology : 0 (base)
      Active Timer: 3 min
      Distance: internal 90 external 170
      Maximum path: 4
      Maximum hopcount 100
      Maximum metric variance 1
  Automatic Summarization: disabled
  Maximum path: 4
  Routing for Networks:
    0.0.0.0
  Passive Interface(s):
    FastEthernet0/0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.1.94         90      00:06:16
  Distance: internal 90 external 170
```

LAB 26: Redistribution with Route-Map

OBJECTIVE:

To configure a Route Map to influence howroutes get redistributed

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Configure OSPF and EIGRP on routers as per given topology.
3) Configure Redistribution.
4) Configure Route – Maps in such a way that 40.0.0.0 networks will be redistributed into OSPF with different metrics.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure EIGRP between R1 and R4 routers

   R1(config)#router eigrp 100
   R1(config-router)#network 192.168.X.92

R1(config-router)# no auto-summary
R4(Config)# router eigrp 100
R4(Config-router)# network 40.0.0.0
R4(Config-router)# network 192.168.X.0
R4(config-router)# no auto-summary

4) Configure OSPF AREA 0 in R1 and R2 routers.

R1(config)# router ospf 100
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
R2 (config)#router ospf 100
R2(config-router)#network 20.X.0.0 0.0.255.255 area 0
R2(config-router) #network 192.168.X.32 0.0.0.15 area 0
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0

5) Configure access-list to identify the traffic

R1(config)#access-list 10 permit 40.1.0.0 0.0.255.255
R1(config)#access-list 11 permit 40.1.1.0 0.0.255.255
R1(config)# access-list 12 permit 40.1.2.0 0.0.255.255
R1(config)#access-list 13 permit 40.1.3.0 0.0.255.255

6) Configure Route Maps

R1(config)# route-map zoom permit 1
R1(config-route-map)#match ip address 10
R1(config-route-map)#set metric 100
R1(config-route-map)#exit
R1(config)#route-map zoom permit 2
R1(config-route-map)#match ip address 11
R1(config-route-map)#set metric 200
R1(config-route-map)#exit
R1(config)#route-map zoom permit 3
R1(config-route-map)#match ip address 12
R1(config-route-map)#set metric 300
R1(config-route-map)#exit
R1(config)#route-map zoom permit 4
R1(config-route-map)#match ip address 13
R1(config-route-map)#set metric 400
R1(config-route-map)#exit

7) Configure Redistribution from OSPF into EIGRP with route-map

R1(config)#router ospf 1
R1(config-router)#redistribute eigrp 100 route-map zoom subnets

VERIFICATION:

R2#show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

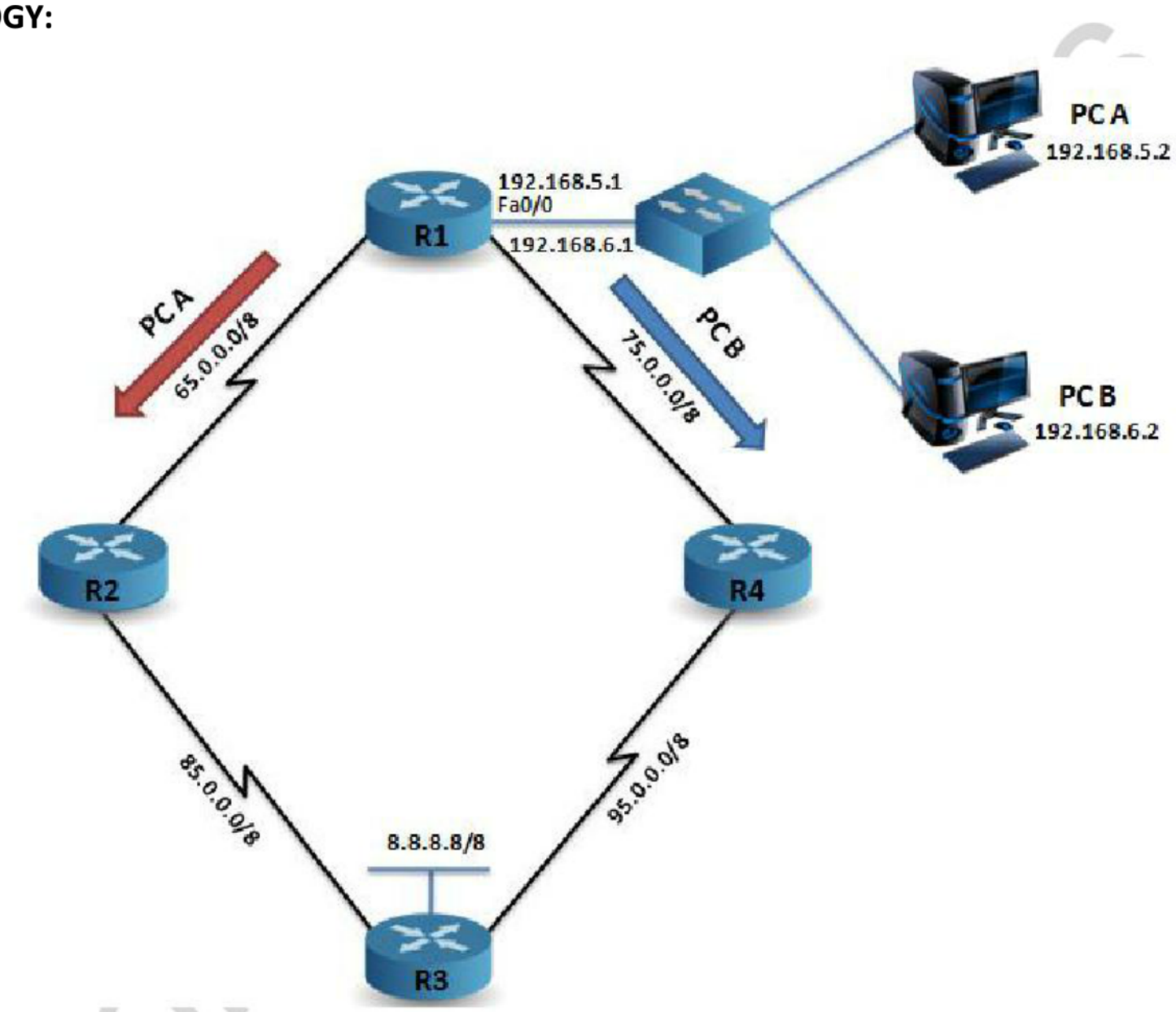
```
        E1 - OSPF external type 1, E2 - OSPF external type 2
        i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
        ia - IS-IS inter area, * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route, + - replicated route

Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.20.0/24 is directly connected, FastEthernet0/1
L       10.1.20.1/32 is directly connected, FastEthernet0/1
     20.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.2.0/24 is directly connected, Loopback2
L       20.1.2.1/32 is directly connected, Loopback2
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     40.0.0.0/24 is subnetted, 4 subnets
O E2    40.1.0.0 [110/100] via 192.168.1.81, 00:00:05, Serial0/0/1
O E2    40.1.1.0 [110/200] via 192.168.1.81, 00:00:05, Serial0/0/1
O E2    40.1.2.0 [110/300] via 192.168.1.81, 00:00:05, Serial0/0/1
O E2    40.1.3.0 [110/400] via 192.168.1.81, 00:00:05, Serial0/0/1
     192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
```

LAB 27: POLICY BASED ROUTING

OBJECTIVE:

Configure Policy Based Routing in R1 router such that PC A traffic should go via R2 and PC B traffic should go via R4 router.

TOPOLOGY:



TASK:

1) Assign IP addresses on Lan interface of R1 router
2) Configure Access-lists to Identify traffic
3) Implement Policy Based Routing using Route-Map.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Assign IP address on the LAN interface (FA0/0) of the R1 router.

R1(config)#interface fastethernet0/0

R1(config-if)#ip address 192.168.5.1 255.255.255.0

R1(config-if)#ip address 192.168.6.1 255.255.255.0 secondary

3) Configure Access-list to match the traffic generated by PC A and PC B.

R1(config)# access-list 11 permit 192.168.5.0 0.0.0.255

R1(config)# access-list 12 permit 192.168.6.0 0.0.0.255

4) Configure Route-Map to implement Policy Based Routing.

R1 (config)# route-map zoom permit 10

R1 (config-route-map) # match ip address 11

R1 (config-route-map) # set interface serial 1/0

R1 (config-route-map) #exit

R1 (config)# route-map zoom permit 20

R1 (config-route-map) # match ip address 12

R1(config-route-map) # set interface serial 1/1

R1(config-route-map) #exit

5) Implement Route-Map on the LAN interface of the R1 Router.

R1(config)#interface fastethernet0/0

R1(config-if)#ip policy route-map zoom

VERIFICATION:

R1#show ip policy

```
Interface      Route map
Fa0/0          zoom
R1#show route-map
route-map zoom, permit, sequence 1
  Match clauses:
    ip address (access-lists): 11
  Set clauses:
    interface Serial0/1/0
  Policy routing matches: 0 packets, 0 bytes
route-map zoom, permit, sequence 2
  Match clauses:
    ip address (access-lists): 12
  Set clauses:
    interface Serial0/1/1
  Policy routing matches: 0 packets, 0 bytes
```

PC A Traceroute output

```
root@box:~# traceroute 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets
 1  192.168.5.1 (192.168.5.1)  22.441 ms  21.744 ms  10.406 ms
 2  65.0.0.2 (65.0.0.2)  61.659 ms  31.065 ms  23.289 ms
 3  85.0.0.2 (85.0.0.2)  52.732 ms  34.668 ms  49.872 ms
root@box:~#
```

PC B Traceroute output

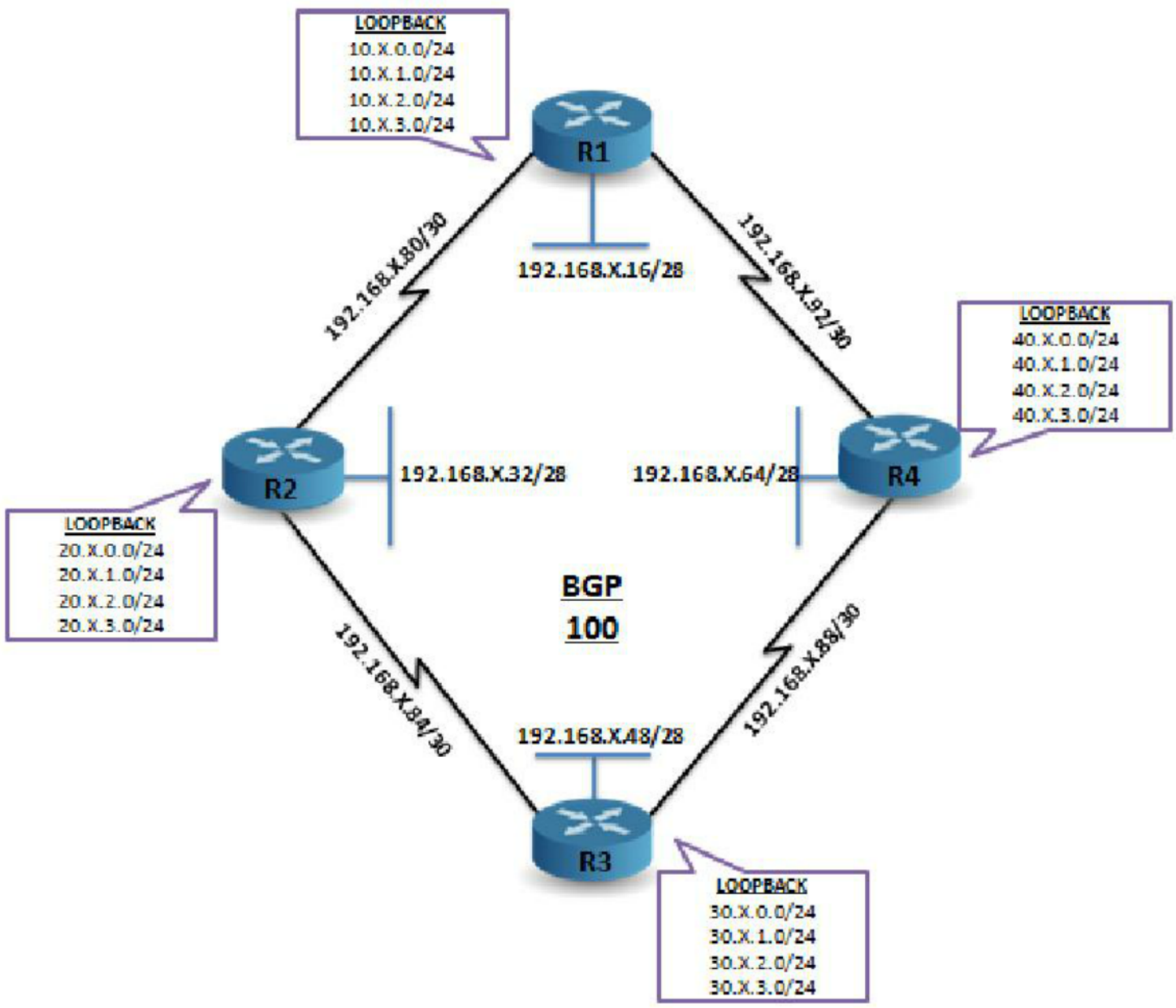
```
root@box:~# traceroute 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets
 1  192.168.5.1 (192.168.5.1)  34.957 ms  13.117 ms  41.513 ms
 2  75.0.0.2 (75.0.0.2)  29.573 ms  27.041 ms  66.985 ms
 3  95.0.0.2 (95.0.0.2)  45.920 ms  46.816 ms  79.911 ms
```

LAB 28: BGP

OBJECTIVE:

To establish connectivity between networks by configuring BGP on all routers

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers by using AS number 100
4) Verify Tables in BGP
5) Verify the connectivity using Ping command.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP on all routers using AS number 100

```
R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 100
R1(config-router)#neighbor 192.168.X.93 remote-as 100
R1(config-router)#neighbor 192.168.X.86 remote-as 100
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 192.168.X.92 mask 255.255.255.252
R1(config-router)#network 192.168.X.80 mask 255.255.255.252
R1(config-router)#network 10.1.0.0  mask 255.255.255.0
R1(config-router)#network 10.1.1.0 mask 255.255.255.0
R1(config-router)#network 10.1.2.0 mask 255.255.255.0
R1(config-router)#network 10.1.3.0 mask 255.255.255.0
R1(config-router)#no synchronization
R1(config-router)#end
R2(config)# router bgp 100
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#neighbor 192.168.X.86 remote-as 100
R2(config-router)#neighbor 192.168.X.93 remote-as 100
R2(config-router)#network 192.168.X.80 mask 255.255.255.252
R2(config-router)#network 192.168.X.84 mask 255.255.255.252
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#network 20.1.0.0  mask 255.255.255.0
R2(config-router)#network 20.1.1.0 mask 255.255.255.0
R2(config-router)#network 20.1.2.0 mask 255.255.255.0
R2(config-router)#network 20.1.3.0 mask 255.255.255.0
R2(config-router)#no synchronization
R2(config-router)#end
R3(config)#router bgp 100
R3(config-router)# neighbor 192.168.X.90 remote-as 100
R3(config-router)# neighbor 192.168.X.81 remote-as 100
R3(config-router)# neighbor 192.168.X.85 remote-as 100
R3(config-router)# network 192.168.X.88 mask 255.255.255.252
R3(config-router)# network 192.168.X.84 mask 255.255.255.252
R3(config-router)# network 192.168.X.48 mask 255.255.255.240
R3(config-router)#network 30.1.0.0  mask 255.255.255.0
R3(config-router)#network 30.1.1.0 mask 255.255.255.0
R3(config-router)#network 30.1.2.0 mask 255.255.255.0
R3(config-router)#network 30.1.3.0 mask 255.255.255.0
R3(config-router)#no synchronization
R3(config-router)#end
R4(config)# router bgp 100
R4(config-router)#neighbor 192.168.X.94 remote-as 100
```

```
R4(config-router)#neighbor 192.168.X.89 remote-as 100
R4(config-router)#neighbor 192.168.X.82 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.88 mask 255.255.255.252
R4(config-router)#network 192.168.X.92 mask 255.255.255.252
R4(config-router)#network 40.1.0.0  mask 255.255.255.0
R4(config-router)#network 40.1.1.0 mask 255.255.255.0
R4(config-router)#network 40.1.2.0 mask 255.255.255.0
R4(config-router)#network 40.1.3.0 mask 255.255.255.0
R4(config-router)#no synchronization
R4(config-router)#end
```

VERIFICATION:

Check the BGP neighbor table, Database table and Routing Table on all the routers.

➔ **To check Neighbor Table use following command in all routers**

R1, R2, R3, R4#show ip bgp summary

R1#show ip bgp summary

```
BGP router identifier 10.1.3.1, local AS number 100
BGP table version is 7, main routing table version 7
6 network entries using 816 bytes of memory
8 path entries using 416 bytes of memory
2/2 BGP path/bestpath attribute entries using 248 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 1480 total bytes of memory
BGP activity 6/0 prefixes, 8/0 paths, scan interval 60 secs
```

Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State /PfxRcd
192.168.1.82	4	100	15	15	32	0	0	00:07:50	7
192.168.1.86	4	100	4	5	32	0	0	00:00:15	7
192.168.1.93	4	100	14	15	32	0	0	00:07:13	7

➔ **To check Database Table use following command in all routers**

R1, R2, R3, R4#show ip bgp

R1#show ip bgp

```
BGP table version is 8, local router ID is 10.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, x best-external
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.0.0/24      0.0.0.0                  0         32768 i
*> 10.1.1.0/24      0.0.0.0                  0         32768 i
*> 10.1.2.0/24      0.0.0.0                  0         32768 i
*> 10.1.3.0/24      0.0.0.0                  0         32768 i
*>i20.1.0.0/24      192.168.1.82             0    100      0 i
*>i20.1.1.0/24      192.168.1.82             0    100      0 i
*>i20.1.2.0/24      192.168.1.82             0    100      0 i
*>i20.1.3.0/24      192.168.1.82             0    100      0 i
```

*>i30.1.0.0/24	192.168.1.86	0	100	0 i
*>i30.1.1.0/24	192.168.1.86	0	100	0 i
*>i30.1.2.0/24	192.168.1.86	0	100	0 i
*>i30.1.3.0/24	192.168.1.86	0	100	0 i
*>i40.1.0.0/24	192.168.1.93	0	100	0 i

➔ **To check Routing Table use following command in all routers**

R1, R2, R3, R4#show ip route

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       10.1.0.0/24 is directly connected, Loopback0
L       10.1.0.1/32 is directly connected, Loopback0
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     20.0.0.0/24 is subnetted, 4 subnets
B       20.1.0.0 [200/0] via 192.168.1.82, 00:03:35
B       20.1.1.0 [200/0] via 192.168.1.82, 00:03:31
B       20.1.2.0 [200/0] via 192.168.1.82, 00:03:27
B       20.1.3.0 [200/0] via 192.168.1.82, 00:03:22
     30.0.0.0/24 is subnetted, 4 subnets
B       30.1.0.0 [200/0] via 192.168.1.86, 00:01:25
B       30.1.1.0 [200/0] via 192.168.1.86, 00:01:25
B       30.1.2.0 [200/0] via 192.168.1.86, 00:01:25
B       30.1.3.0 [200/0] via 192.168.1.86, 00:01:25
     40.0.0.0/24 is subnetted, 4 subnets
B       40.1.0.0 [200/0] via 192.168.1.93, 00:03:58
B       40.1.1.0 [200/0] via 192.168.1.93, 00:03:55
B       40.1.2.0 [200/0] via 192.168.1.93, 00:03:52
B       40.1.3.0 [200/0] via 192.168.1.93, 00:03:49
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/30 is directly connected, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
     192.168.1.0/24 is variably subnetted, 9 subnets, 3 masks
B       192.168.1.32/28 [200/0] via 192.168.1.82, 00:07:49
B       192.168.1.48/28 [200/0] via 192.168.1.86, 00:01:25
B       192.168.1.64/28 [200/0] via 192.168.1.93, 00:07:15
C       192.168.1.80/30 is directly connected, Serial0/1/1
```

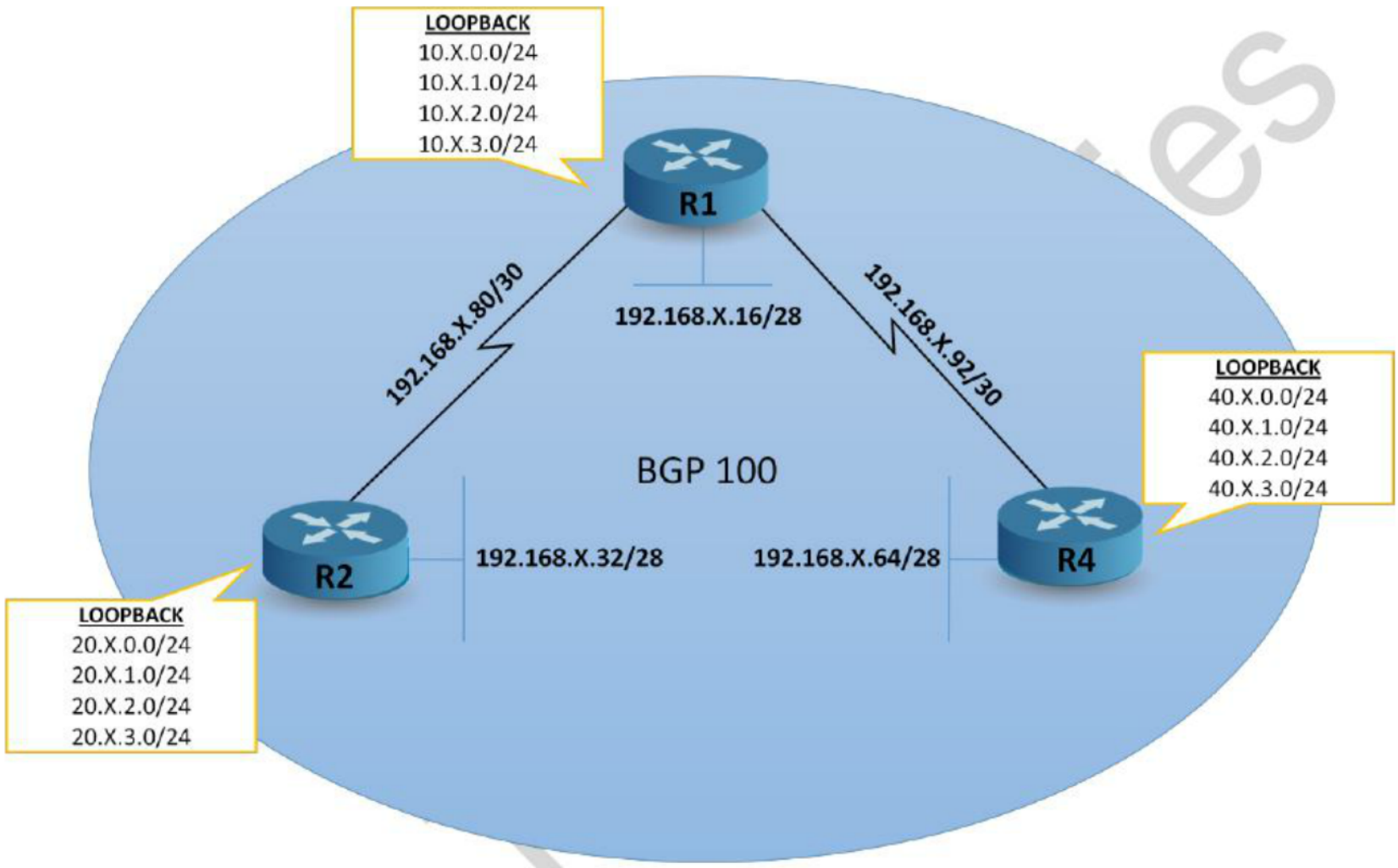
```
L       192.168.1.81/32 is directly connected, Serial0/1/1
B       192.168.1.84/30 [200/0] via 192.168.1.82, 00:07:49
B       192.168.1.88/30 [200/0] via 192.168.1.86, 00:01:25
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
    192.168.5.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.5.0/24 is directly connected, FastEthernet0/0
L       192.168.5.1/32 is directly connected, FastEthernet0/0
    192.168.6.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.6.0/24 is directly connected, FastEthernet0/0
L       192.168.6.1/32 is directly connected, FastEthernet0/0
```

LAB 29: BGP SPLIT HORIZON

OBJECTIVE:

To configure and verify the behaviour of BGP Split Horizon

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers by using AS number 100
4) Verify Tables in BGP
5) Verify Split Horizon

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP on all routers using AS number 100

R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 100
R1(config-router)#neighbor 192.168.X.93 remote-as 100
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 192.168.X.92 mask 255.255.255.252
R1(config-router)#network 192.168.X.80 mask 255.255.255.252
R1(config-router)#no synchronization
R1(config-router)#end
R2(config)# router bgp 100
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#network 192.168.X.80 mask 255.255.255.252
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#no synchronization
R2(config-router)#end
R4(config)# router bgp 100
R4(config-router)#neighbor 192.168.X.94 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.92 mask 255.255.255.252
R4(config-router)#no synchronization
R4(config-router)#end

4) Verify BGP tables in all routers

R1,R2,R3,R4# show ip bgp summary
R1,R2,R3,R4# show ip bgp
R1,R2,R3,R4# show ip route

VERIFICATION:

➔ **Verify the output in each router. R1 router gets update from both R2 and R4, but R2 and R4 cannot see updates of each other's LAN in their routing table. This is split horizion.**
R1# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static rout
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override
Gateway of last resort is not set
10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 10.1.0.0/24 is directly connected, Loopback0
L 10.1.0.1/32 is directly connected, Loopback0
C 10.1.1.0/24 is directly connected, Loopback1
L 10.1.1.1/32 is directly connected, Loopback1
C 10.1.2.0/24 is directly connected, Loopback2
L 10.1.2.1/32 is directly connected, Loopback2
C 10.1.3.0/24 is directly connected, Loopback3
L 10.1.3.1/32 is directly connected, Loopback3

```
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/30 is directly connected, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
B       192.168.1.32/28 [200/0] via 192.168.1.82, 00:01:42
B       192.168.1.64/28 [200/0] via 192.168.1.93, 00:01:41
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
B       192.168.1.84/30 [200/0] via 192.168.1.82, 00:01:42
B       192.168.1.88/30 [200/0] via 192.168.1.93, 00:01:41
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

R2# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.20.0/24 is directly connected, FastEthernet0/1
L       10.1.20.1/32 is directly connected, FastEthernet0/1
     20.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.2.0/24 is directly connected, Loopback2
L       20.1.2.1/32 is directly connected, Loopback2
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
B       192.168.1.16/28 [200/0] via 192.168.1.81, 00:00:24
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
B       192.168.1.92/30 [200/0] via 192.168.1.81, 00:01:15
```

R4# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
```

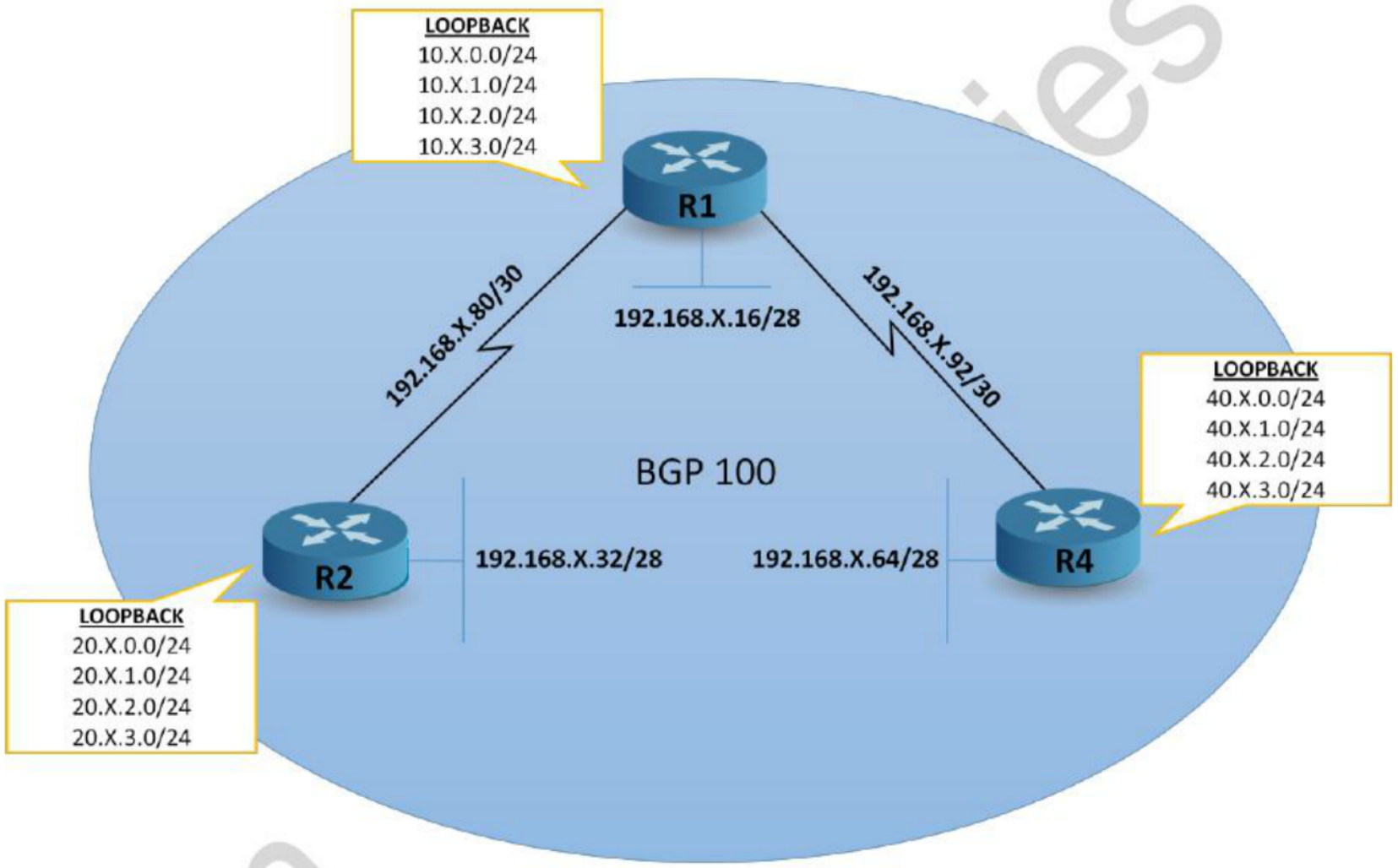
```
      o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
      + - replicated route, % - next hop override
Gateway of last resort is not set
     40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       40.1.0.0/24 is directly connected, Loopback0
L       40.1.0.1/32 is directly connected, Loopback0
C       40.1.1.0/24 is directly connected, Loopback1
L       40.1.1.1/32 is directly connected, Loopback1
C       40.1.2.0/24 is directly connected, Loopback2
L       40.1.2.1/32 is directly connected, Loopback2
C       40.1.3.0/24 is directly connected, Loopback3
L       40.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
B       192.168.1.16/28 [200/0] via 192.168.1.94, 00:00:13
C       192.168.1.64/28 is directly connected, FastEthernet0/0
L       192.168.1.65/32 is directly connected, FastEthernet0/0
B       192.168.1.80/30 [200/0] via 192.168.1.94, 00:01:03
C       192.168.1.88/30 is directly connected, Serial0/0/1
L       192.168.1.90/32 is directly connected, Serial0/0/1
C       192.168.1.92/30 is directly connected, Serial0/0/0
L       192.168.1.93/32 is directly connected, Serial0/0/0
```

LAB 30: ROUTE REFLECTOR

OBJECTIVE:

To configure route reflector so that all internal routers in the AS get BGP updates only from the route reflector

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers by using AS number 100
4) Verify Tables in BGP
5) Configure R1 router as Route Reflector Server and R2,R4 router as Route Reflector Clients.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP on all routers using AS number 100

R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 100
R1(config-router)#neighbor 192.168.X.93 remote-as 100
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 192.168.X.92 mask 255.255.255.252
R1(config-router)#network 192.168.X.80 mask 255.255.255.252
R1(config-router)#no synchronization
R1(config-router)#end
R2(config)# router bgp 100
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#network 192.168.X.80 mask 255.255.255.252
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#no synchronization
R2(config-router)#end
R4(config)# router bgp 100
R4(config-router)#neighbor 192.168.X.94 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.92 mask 255.255.255.252
R4(config-router)#no synchronization
R4(config-router)#end

4) Verify BGP tables in all routers

R1,R2,R3,R4# show ip bgp summary
R1,R2,R3,R4# show ip bgp
R1,R2,R3,R4# show ip route

5) Configure R1 as Route Reflector Server and R2, R4 as Route Reflector Clients.

R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 route-reflector-client
R1(config-router)#neighbor 192.168.X.93 route-reflector-client
R1(config-router)#end

VERIFICATION:

➔ **Verify the output in R2 and R4, R2 Should get the update of LAN network of R4 and R4 should get the update of LAN network of R2.**

R2#show ip bgp
BGP table version is 12, local router ID is 20.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf	Weight	Path
*>i192.168.1.16/28	192.168.1.81	0	100	0	i
*> 192.168.1.32/28	0.0.0.0	0		32768	i
***>i192.168.1.64/28**	**192.168.1.93**	**0**	**100**	**0**	**i**
* i192.168.1.80/30	192.168.1.81	0	100	0	i
*>	0.0.0.0	0		32768	i

*>i192.168.1.92/30 192.168.1.81   0   100   0 i

R4#show ip bgp

BGP table version is 12, local router ID is 40.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf	Weight	Path
*>i192.168.1.16/28	192.168.1.94	0	100	0	i
***>i192.168.1.32/28**	**192.168.1.82**	**0**	**100**	**0**	**i**
*> 192.168.1.64/28	0.0.0.0	0		32768	i
*>i192.168.1.80/30	192.168.1.94	0	100	0	i
* i192.168.1.92/30	192.168.1.94	0	100	0	i
*>	0.0.0.0	0		32768	i

R4# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override

Gateway of last resort is not set

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
B 192.168.1.16/28 [200/0] via 192.168.1.94, 00:00:07
B 192.168.1.32/28 [200/0] via 192.168.1.82, 00:00:07
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
B 192.168.1.80/30 [200/0] via 192.168.1.94, 00:00:07
B 192.168.1.84/30 [200/0] via 192.168.1.82, 00:00:07
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0

R2# show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

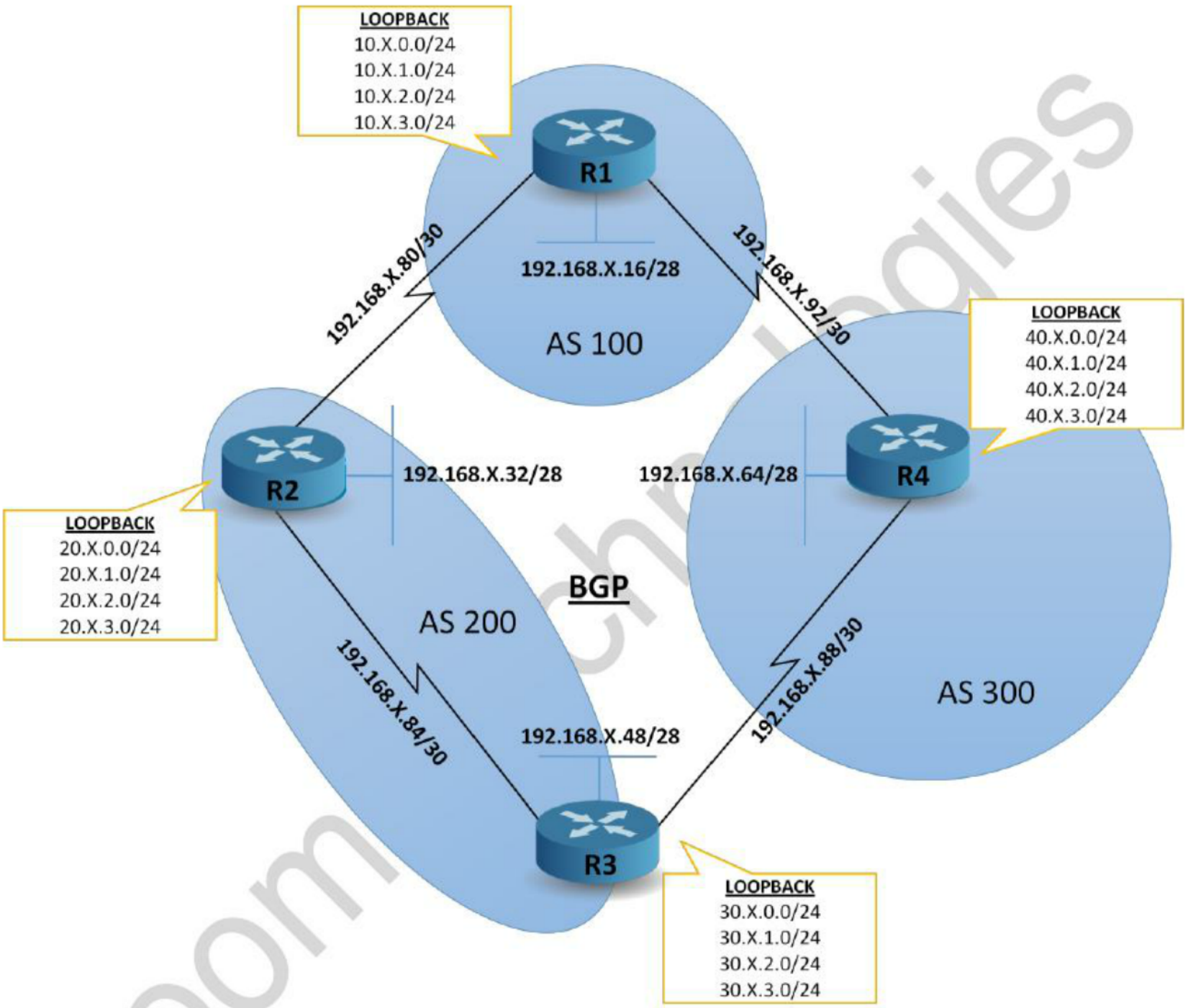
```
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route, + - replicated route
Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.20.0/24 is directly connected, FastEthernet0/1
L       10.1.20.1/32 is directly connected, FastEthernet0/1
     20.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       20.1.0.0/24 is directly connected, Loopback0
L       20.1.0.1/32 is directly connected, Loopback0
C       20.1.1.0/24 is directly connected, Loopback1
L       20.1.1.1/32 is directly connected, Loopback1
C       20.1.2.0/24 is directly connected, Loopback2
L       20.1.2.1/32 is directly connected, Loopback2
C       20.1.3.0/24 is directly connected, Loopback3
L       20.1.3.1/32 is directly connected, Loopback3
     192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
B       192.168.1.16/28 [200/0] via 192.168.1.81, 00:01:01
C       192.168.1.32/28 is directly connected, FastEthernet0/0
L       192.168.1.33/32 is directly connected, FastEthernet0/0
B       192.168.1.64/28 [200/0] via 192.168.1.93, 00:00:51
C       192.168.1.80/30 is directly connected, Serial0/0/1
L       192.168.1.82/32 is directly connected, Serial0/0/1
C       192.168.1.84/30 is directly connected, Serial0/0/0
L       192.168.1.85/32 is directly connected, Serial0/0/0
B       192.168.1.88/30 [200/0] via 192.168.1.93, 00:00:51
B       192.168.1.92/30 [200/0] via 192.168.1.81, 00:01:01
```

LAB 31: EBGP (External BGP)

OBJECTIVE:

To configure BGP over multiple ASs (external BGP)

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers as shown in topology
4) Check that alll routers form neighbor relationships and BGP routes show up in their routing tables

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP in all the routers

```
R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 200
R1(config-router)#neighbor 192.168.X.93 remote-as 300
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 10.X.0.0  mask 255.255.255.0
R1(config-router)#network 10.X.1.0  mask 255.255.255.0
R1(config-router)#network 10.X.2.0  mask 255.255.255.0
R1(config-router)#network 10.X.3.0  mask 255.255.255.0
R1(config-router)#no synchronization
R2(config)# router bgp 200
R2(config-router)# neighbor 192.168.X.81 remote-as 100
R2(config-router)# neighbor 192.168.X.86 remote-as 200
R2(config-router)#network 192.168.X.84 mask 255.255.255.252
R2(config-router)# network 192.168.X.32 mask 255.255.255.240
R2(config-router)#network 20.X.0.0 mask 255.255.255.0
R2(config-router)#network 20.X.1.0 mask 255.255.255.0
R2(config-router)#network 20.X.2.0 mask 255.255.255.0
R2(config-router)#network 20.X.3.0 mask 255.255.255.0
R2(config-router)#neighbor 192.168.X.86 next-hop-self
R2(config-router)# no synchronization
R3(config)# router bgp 200
R3(config-router)# neighbor 192.168.X.85 remote-as 200
R3(config-router)# neighbor 192.168.X.90 remote-as 300
R3(config-router)#network 30.X.0.0 mask 255.255.255.0
R3(config-router)#network 30.X.1.0 mask 255.255.255.0
R3(config-router)#network 30.X.2.0 mask 255.255.255.0
R3(config-router)#network 30.X.3.0 mask 255.255.255.0
R3(config-router)#neighbor 192.168.X.85 next-hop-self
R3(config-router)#no synchronization
R4(config)#router bgp 300
R4(config-router)#neighbor 192.168.X.94 remote 100
R4(config-router)#neighbor 192.168.X.89 remote-as 200
R4(config-router)# network 40.X.0.0 mask 255.255.255.0
R4(config-router)# network 40.X.1.0 mask 255.255.255.0
R4(config-router)# network 40.X.2.0 mask 255.255.255.0
R4(config-router)# network 40.X.3.0 mask 255.255.255.0
R4(config-router)#no synchronization
```

4) Verify BGP tables in all routers

   R1,R2,R3,R4# show ip bgp summary

R1,R2,R3,R4# show ip bgp
R1,R2,R3,R4# show ip route

VERIFICATION:

➔ **Check the routing table in all the routers.**

R1,R2,R3,R4#show ip route
R1# show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        10.1.0.0/24 is directly connected, Loopback0
L        10.1.0.1/32 is directly connected, Loopback0
C        10.1.1.0/24 is directly connected, Loopback1
L        10.1.1.1/32 is directly connected, Loopback1
C        10.1.2.0/24 is directly connected, Loopback2
L        10.1.2.1/32 is directly connected, Loopback2
C        10.1.3.0/24 is directly connected, Loopback3
L        10.1.3.1/32 is directly connected, Loopback3
     20.0.0.0/24 is subnetted, 4 subnets
B       20.1.0.0 [20/0] via 192.168.1.82, 00:09:30
B       20.1.1.0 [20/0] via 192.168.1.82, 00:09:30
B       20.1.2.0 [20/0] via 192.168.1.82, 00:09:30
B       20.1.3.0 [20/0] via 192.168.1.82, 00:09:30
     30.0.0.0/24 is subnetted, 4 subnets
B       30.1.0.0 [20/0] via 192.168.1.82, 00:08:33
B       30.1.1.0 [20/0] via 192.168.1.82, 00:08:33
B       30.1.2.0 [20/0] via 192.168.1.82, 00:08:33
B       30.1.3.0 [20/0] via 192.168.1.82, 00:08:33
     40.0.0.0/24 is subnetted, 4 subnets
B       40.1.0.0 [20/0] via 192.168.1.93, 00:00:11
B       40.1.1.0 [20/0] via 192.168.1.93, 00:00:11
B       40.1.2.0 [20/0] via 192.168.1.93, 00:00:11
B       40.1.3.0 [20/0] via 192.168.1.93, 00:00:11
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.16.1.0/30 is directly connected, Serial0/3/1
L        172.16.1.2/32 is directly connected, Serial0/3/1
     192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C        192.168.1.16/28 is directly connected, FastEthernet0/0
L        192.168.1.17/32 is directly connected, FastEthernet0/0
C        192.168.1.80/30 is directly connected, Serial0/1/1
L        192.168.1.81/32 is directly connected, Serial0/1/1
B        192.168.1.84/30 [20/0] via 192.168.1.82, 00:09:30
C        192.168.1.92/30 is directly connected, Serial0/1/0
L        192.168.1.94/32 is directly connected, Serial0/1/0
```

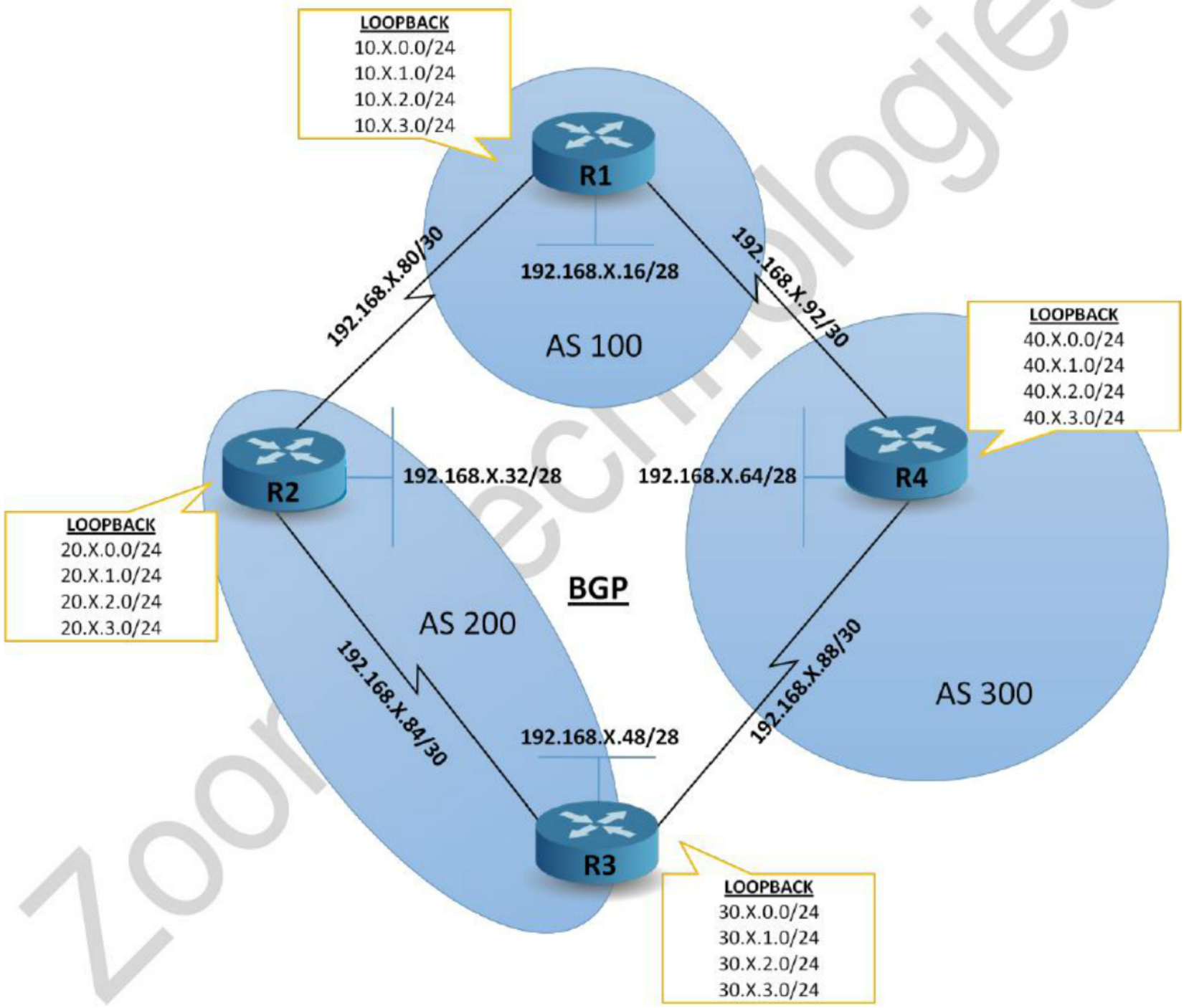
LAB 32: BGP LOCAL PREFERENCE

OBJECTIVE:

To change the local preference BGP attribute to influence which path is used for outbound traffic.

To make packets from R1 to R4's loopback interface go via R2 and R3 , instead of the direct connection , by changing LOCAL_PREF.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers as shown in topology

4) Configure a route map on R1 to identify the networks for which the traffic should take a different path (in this case , 40.0.0.0/24 , the loopback network of R4)
5) Change the local preference on R1 for the route to 40.0.0.0/24 learnt via R2 , so that the path via R2 is chosen.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP in all the routers as done in previous lab
4) Configure route map on R1 to identify the traffic which needs to take a different path and set the local preference to 800.

   R1(config)# access-list 40 permit 40.1.0.0 0.0.255.255
   R1(config)# route-map zoom permit 10
   R1(config-route-map)#match ip address 40
   R1(config-route-map)# set local preference 800
   R1(config-route-map)#exit

5) Use this route map for a neighbour relationship with R2 , so that routes via R2 to 40.0.0.0/24 have a higher local preference.

   R1(config)#router bgp 100
   R1(config-router)#neighbor 192.168.X.82 route-map zoom in

VERIFICATION:

➔ **Before Configuring Local Preference**

R1# show ip bgp

BGP table version is 18, local router ID is 10.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.1.0.0/24	0.0.0.0	0		32768	i
*> 10.1.1.0/24	0.0.0.0	0		32768	i
*> 10.1.2.0/24	0.0.0.0	0		32768	i
*> 10.1.3.0/24	0.0.0.0	0		32768	i
* 20.1.0.0/24	192.168.1.93	0		300	200 i
*>	192.168.1.82	0		0	200 i
* 20.1.1.0/24	192.168.1.93			0	300 200 i
*>	192.168.1.82	0		0	200 i

* 20.1.2.0/24	192.168.1.93		0 300 200 i
*>	192.168.1.82	0	0 200 i
* 20.1.3.0/24	192.168.1.93		0 300 200 i
*>	192.168.1.82	0	0 200 i
* 30.1.0.0/24	192.168.1.93		0 300 200 i
*>	192.168.1.82		0 200 i
* 30.1.1.0/24	192.168.1.93		0 300 200 i
*>	192.168.1.82		0 200 i
* 30.1.2.0/24	192.168.1.93		0 300 200 i
*>	192.168.1.82		0 200 i
* 30.1.3.0/24	192.168.1.93		0 300 200 i
*>	192.168.1.82		0 200 i
* 40.1.0.0/24	192.168.1.82		0 200 300 i
*>	192.168.1.93	0	0 300 i
* 40.1.1.0/24	192.168.1.82		0 200 300 i
*>	192.168.1.93	0	0 300 i
* 40.1.2.0/24	192.168.1.82		0 200 300 i
*>	192.168.1.93	0	0 300 i
* 40.1.3.0/24	192.168.1.82		0 200 300 i
*>	192.168.1.93	0	0 300 i

R1 # show ip route

```
    10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       10.1.0.0/24 is directly connected, Loopback0
L       10.1.0.1/32 is directly connected, Loopback0
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
    20.0.0.0/24 is subnetted, 4 subnets
B       20.1.0.0 [20/0] via 192.168.1.82, 00:09:30
B       20.1.1.0 [20/0] via 192.168.1.82, 00:09:30
B       20.1.2.0 [20/0] via 192.168.1.82, 00:09:30
B       20.1.3.0 [20/0] via 192.168.1.82, 00:09:30
    30.0.0.0/24 is subnetted, 4 subnets
B       30.1.0.0 [20/0] via 192.168.1.82, 00:08:33
B       30.1.1.0 [20/0] via 192.168.1.82, 00:08:33
B       30.1.2.0 [20/0] via 192.168.1.82, 00:08:33
B       30.1.3.0 [20/0] via 192.168.1.82, 00:08:33
    40.0.0.0/24 is subnetted, 4 subnets
B       40.1.0.0 [20/0] via 192.168.1.93, 00:00:11
B       40.1.1.0 [20/0] via 192.168.1.93, 00:00:11
B       40.1.2.0 [20/0] via 192.168.1.93, 00:00:11
B       40.1.3.0 [20/0] via 192.168.1.93, 00:00:11
    172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/30 is directly connected, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
    192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
```

C 192.168.1.80/30 is directly connected, Serial0/1/1
L 192.168.1.81/32 is directly connected, Serial0/1/1
B 192.168.1.84/30 [20/0] via 192.168.1.82, 00:09:30
C 192.168.1.92/30 is directly connected, Serial0/1/0
L 192.168.1.94/32 is directly connected, Serial0/1/0

R1#traceroute 40.1.0.1
Type escape sequence to abort.
Tracing the route to 40.1.0.1
1 192.168.1.93 96 msec 36 msec 24 msec

➔ **After Configuring Local Preference**

R1# clear ip bgp * soft
R1# show ip bgp
BGP table version is 31, local router ID is 10.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.1.0.0/24	0.0.0.0	0		32768	i
*> 10.1.1.0/24	0.0.0.0	0		32768	i
*> 10.1.2.0/24	0.0.0.0	0		32768	i
*> 10.1.3.0/24	0.0.0.0	0		32768	i
*> 20.1.0.0/24	192.168.1.93	0		300	200 i
*> 20.1.1.0/24	192.168.1.93			0 300	200 i
*> 20.1.2.0/24	192.168.1.93			0 300	200 i
*> 20.1.3.0/24	192.168.1.93			0 300	200 i
*> 30.1.0.0/24	192.168.1.93			0 300	200 i
*> 30.1.1.0/24	192.168.1.93			0 300	200 i
*> 30.1.2.0/24	192.168.1.93			0 300	200 i
*> 30.1.3.0/24	192.168.1.93			0 300	200 i
***> 40.1.0.0/24**	**192.168.1.82**	**800**		**0 200**	**300 i**
*	**192.168.1.93**	**0**		**0 300**	**i**
***> 40.1.1.0/24**	**192.168.1.82**	**800**		**0 200**	**300 i**
*	**192.168.1.93**	**0**		**0 300**	**i**
***> 40.1.2.0/24**	**192.168.1.82**	**800**		**0 200**	**300 i**
*	**192.168.1.93**	**0**		**0 300**	**i**
***> 40.1.3.0/24**	**192.168.1.82**	**800**		**0 200**	**300 i**
*	**192.168.1.93**	**0**		**0 300**	**i**
*> 192.168.1.84/30	192.168.1.93			0 300	200 i

R1 # show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override
Gateway of last resort is not set

```
     10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       10.1.0.0/24 is directly connected, Loopback0
L       10.1.0.1/32 is directly connected, Loopback0
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     20.0.0.0/24 is subnetted, 4 subnets
B       20.1.0.0 [20/0] via 192.168.1.93, 00:00:01
B       20.1.1.0 [20/0] via 192.168.1.93, 00:00:01
B       20.1.2.0 [20/0] via 192.168.1.93, 00:00:01
B       20.1.3.0 [20/0] via 192.168.1.93, 00:00:01
     30.0.0.0/24 is subnetted, 4 subnets
B       30.1.0.0 [20/0] via 192.168.1.93, 00:00:01
B       30.1.1.0 [20/0] via 192.168.1.93, 00:00:01
B       30.1.2.0 [20/0] via 192.168.1.93, 00:00:01
B       30.1.3.0 [20/0] via 192.168.1.93, 00:00:01
     40.0.0.0/24 is subnetted, 4 subnets
B       40.1.0.0 [20/0] via 192.168.1.82, 00:00:01
B       40.1.1.0 [20/0] via 192.168.1.82, 00:00:01
B       40.1.2.0 [20/0] via 192.168.1.82, 00:00:01
B       40.1.3.0 [20/0] via 192.168.1.82, 00:00:01
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/30 is directly connected, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
     192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
B       192.168.1.84/30 [20/0] via 192.168.1.93, 00:00:01
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

R1#traceroute 40.1.0.1

```
Type escape sequence to abort.
Tracing the route to 40.1.0.1
  1 192.168.1.82 52 msec 28 msec 32 msec
  2 192.168.1.86 [AS 200] 24 msec 28 msec 88 msec
  3 192.168.1.90 [AS 300] 68 msec 16 msec 44 msec
```

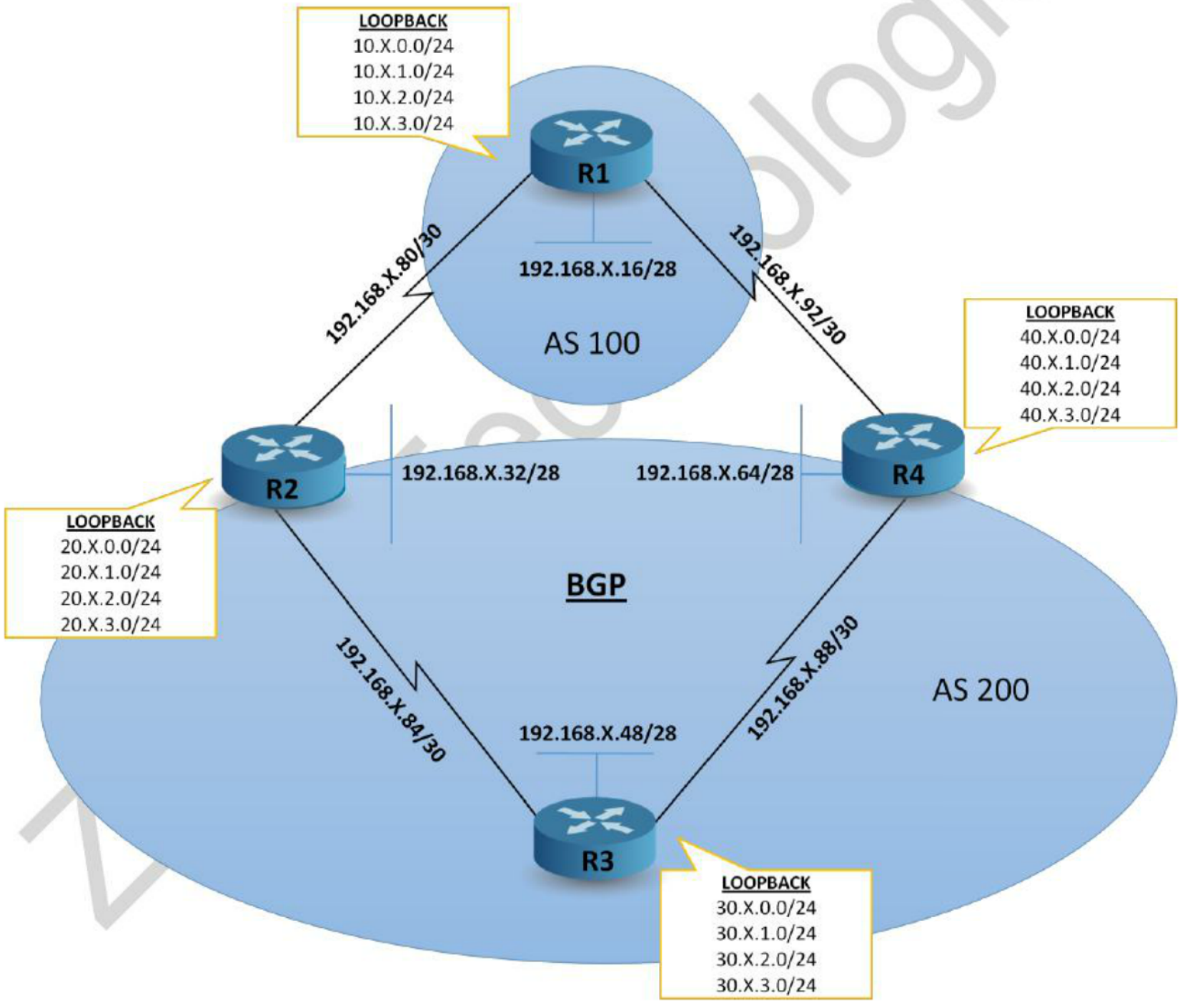
LAB 33: BGP MED (Multi Exit Discriminator)

OBJECTIVE:

To change the MED path attribute to influence inbound routing (which path traffic takes to come into your network).

To influence R1 to send traffic to R3's loopback interface via R4, instead of R2, because of the higher MED received from R2.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers as shown in topology
4) Identify the interesting traffic on R2 with a route map and increase its MED from the default 0

5) Use the route map in the neighbor relationship with R1

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.
   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP in all routers

```
R1(config)# router bgp 100
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#neighbor 192.168.X.82 remote-as 200
R1(config-router)#neighbor 192.168.X.93 remote-as 200
R1(config-router)#end
R2(config)#router bgp 200
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#network 192.168.X.84 mask 255.255.255.252
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#neighbor 192.168.X.86 remote-as 200
R2(config-router)#end
R3(config)#router bgp 200
R3(config-router)# network 192.168.X.84 mask 255.255.255.252
R3(config-router)#network 192.168.X.88 m ask 255.255.255.252
R3(config-router)#network 192.168.X.48 mask 255.255.255.240
R3(config-router)#neighbor 192.168.X.85 remote-as 200
R3(config-router)#neighbor 192.168.X.90 remote-as 200
R3(config-router)#network 30.X.0.0 mask 255.255.255.0
R3(config-router)#network 30.X.1.0 mask 255.255.255.0
R3(config-router)#network 30.X.2.0 mask 255.255.255.0
R3(config-router)#network 30.X.3.0 mask 255.255.255.0
R4(config)# router bgp 200
R4(config-router)#neighbor 192.168.X.89 remote-as 200
R4(config-router)#neighbor 192.168.X.94 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.88 mask 255.255.255.252
R4 (config-router)#end
```

4) Increase the MED value on R2 for the route to 30.0.0.0 /8 from the default value of 0 so that the other route via R4 is preferred

```
R2(config)#access-list 10 permit 30.1.0.0 0.0.255.255
R2(config)#route-map zoom permit 1
R2(config-route-map)#match ip address 10
R2(config-route-map)#set metric 50
R2(config-route-map)#exit
R2(config)#route-map zoom permit 2
R2(config-route-map)#exit
```

5) Use this route map for the neighbor relationship with R1.

R2(config)#router bgp 100
R2(config-router)#neighbor 192.168.X.81 route-map zoom out

VERIFICATION:

➔ **Before Configuring MED**

R1# show ip bgp

BGP table version is 22, local router ID is 10.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.1.0.0/24	0.0.0.0	0		32768	i
*> 10.1.1.0/24	0.0.0.0	0		32768	i
*> 10.1.2.0/24	0.0.0.0	0		32768	i
*> 10.1.3.0/24	0.0.0.0	0		32768	i
*> 20.1.0.0/24	192.168.1.82	0		0	200 i
*> 20.1.1.0/24	192.168.1.82	0		0	200 i
*> 20.1.2.0/24	192.168.1.82	0		0	200 i
*> 20.1.3.0/24	192.168.1.82	0		0	200 i
* 30.1.0.0/24	192.168.1.93			0	200 i
*>	192.168.1.82			0	200 i
* 30.1.1.0/24	192.168.1.93			0	200 i
*>	192.168.1.82			0	200 i
* 30.1.2.0/24	192.168.1.93			0	200 i
*>	192.168.1.82			0	200 i
* 30.1.3.0/24	192.168.1.93			0	200 i
*>	192.168.1.82			0	200 i
*> 40.1.0.0/24	192.168.1.93	0		0	200 i
*> 40.1.1.0/24	192.168.1.93	0		0	200 i
*> 40.1.2.0/24	192.168.1.93	0		0	200 i
*> 40.1.3.0/24	192.168.1.93	0		0	200 i

R1#traceroute 30.1.0.1
Type escape sequence to abort.
Tracing the route to 30.1.0.1

1 192.168.1.82 52 msec 28 msec 32 msec
2 192.168.1.86 [AS 200] 22 msec 26 msec 88 msec

R1# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override

```
Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       10.1.0.0/24 is directly connected, Loopback0
L       10.1.0.1/32 is directly connected, Loopback0
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     30.0.0.0/24 is subnetted, 4 subnets
B       30.1.0.0 [20/0] via 192.168.1.82, 00:02:50
B       30.1.1.0 [20/0] via 192.168.1.82, 00:02:50
B       30.1.2.0 [20/0] via 192.168.1.82, 00:02:50
B       30.1.3.0 [20/0] via 192.168.1.82, 00:02:50
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/30 is directly connected, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
     192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
B       192.168.1.32/28 [20/0] via 192.168.1.82, 00:04:21
B       192.168.1.48/28 [20/0] via 192.168.1.82, 00:03:20
B       192.168.1.64/28 [20/0] via 192.168.1.93, 00:01:29
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
B       192.168.1.84/30 [20/0] via 192.168.1.82, 00:04:21
B       192.168.1.88/30 [20/0] via 192.168.1.82, 00:03:20
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
```

After configuring MED

R1# clear ip bgp * soft

R1# show ip bgp

```
BGP table version is 32, local router ID is 10.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.0.0/24      0.0.0.0                  0         32768 i
*> 10.1.1.0/24      0.0.0.0                  0         32768 i
*> 10.1.2.0/24      0.0.0.0                  0         32768 i
*> 10.1.3.0/24      0.0.0.0                  0         32768 i
*> 30.1.0.0/24      192.168.1.93                       0200 i
*                   192.168.1.82            50         0 200 i
*> 30.1.1.0/24      192.168.1.93                       0 200 i
*                   192.168.1.82            50         0 200 i
*> 30.1.2.0/24      192.168.1.93                       0 200 i
*                   192.168.1.82            50         0 200 i
*> 30.1.3.0/24      192.168.1.93                       0 200 i
*                   192.168.1.82            50         0 200 i
*> 40.1.0.0/24      192.168.1.93             0         0 200 i
```

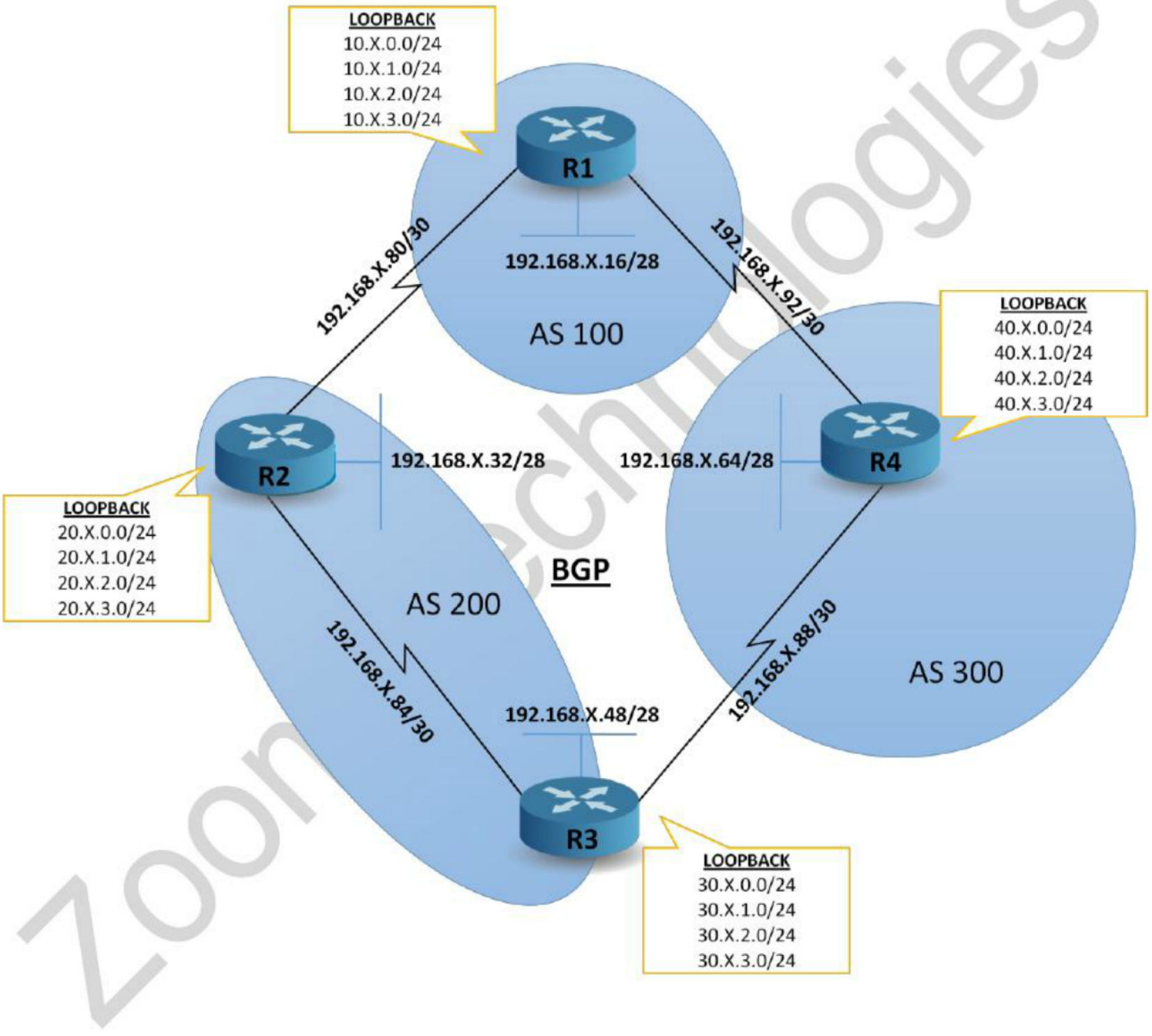
```
*> 40.1.1.0/24     192.168.1.93          0         0 200 i
*> 40.1.2.0/24     192.168.1.93          0         0 200 i
*> 40.1.3.0/24     192.168.1.93          0         0 200 i
*> 192.168.1.84/30  192.168.1.93                   0 200 i
*> 192.168.1.88/30  192.168.1.93       0           0 200 i
R1#
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
Gateway of last resort is not set
     10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C       10.1.0.0/24 is directly connected, Loopback0
L       10.1.0.1/32 is directly connected, Loopback0
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
     30.0.0.0/24 is subnetted, 4 subnets
B       30.1.0.0 [20/0] via 192.168.1.93, 00:01:37
B       30.1.1.0 [20/0] via 192.168.1.93, 00:01:37
B       30.1.2.0 [20/0] via 192.168.1.93, 00:01:37
B       30.1.3.0 [20/0] via 192.168.1.93, 00:01:37
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/30 is directly connected, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
     192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
L       192.168.1.17/32 is directly connected, FastEthernet0/0
B       192.168.1.32/28 [20/50] via 192.168.1.82, 00:01:37
B       192.168.1.48/28 [20/0] via 192.168.1.93, 00:01:37
B       192.168.1.64/28 [20/0] via 192.168.1.93, 00:04:50
C       192.168.1.80/30 is directly connected, Serial0/1/1
L       192.168.1.81/32 is directly connected, Serial0/1/1
B       192.168.1.84/30 [20/0] via 192.168.1.93, 00:01:37
B       192.168.1.88/30 [20/0] via 192.168.1.93, 00:01:37
C       192.168.1.92/30 is directly connected, Serial0/1/0
L       192.168.1.94/32 is directly connected, Serial0/1/0
R1#traceroute 30.1.0.1
Type escape sequence to abort.
Tracing the route to 30.1.0.1
  1 192.168.1.93 42 msec 28 msec 22 msec
  2 192.168.1.89 [AS 200]22 msec 26 msec 88 msec
```

LAB 34: BGP WEIGHT

OBJECTIVE:

To change the Weight BGP attribute to influence which path is used for outbound traffic.
To make packets from R3 to R4's loopback interface go via R2 , instead of the direct connection , by changing the weight.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers as shown in topology

4) Configure a route map on R3 to identify the networks for which the traffic should take a different path (in this case , 40.0.0.0/24 , the loopback network of R4)
5) Change the weight on R3 for the route to 40.0.0.0/24 learnt via R2 , so that the path via R2 is chosen.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP in all the routers as done in EBGP Lab.
4) Configure route map on R3 to identify the traffic which needs to take a different path and set the weight to 45000.

```
R3(config)# access-list 40 permit 40.1.0.0 0.0.255.255
R3(config)# route-map zoom permit 10
R3(config-route-map)#match ip address 40
R3(config-route-map)# set weight 45000
R3(config-route-map)#exit
```

5) Use this route map for a neighbour relationship with R2 , so that routes via R2 to 40.0.0.0/24 have a higher weight.

```
R3(config)#router bgp 200
R3(config-router)#neighbor 192.168.X.85 route-map zoom in
```

VERIFICATION:

➔ **Before Configuring Weight**

R3# show ip bgp

```
BGP table version is 14, local router ID is 30.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.0.0/24      192.168.1.90             0 300 100 i
*> 10.1.1.0/24      192.168.1.90             0 300 100 i
*> 10.1.2.0/24      192.168.1.90             0 300 100 i
*> 10.1.3.0/24      192.168.1.90             0 300 100 i
*> 30.1.0.0/24      0.0.0.0                  0         32768 i
*> 30.1.1.0/24      0.0.0.0                  0         32768 i
*> 30.1.2.0/24      0.0.0.0                  0         32768 i
```

```
*> 30.1.3.0/24     0.0.0.0                0         32768 i
*>  40.1.0.0/24     192.168.1.90           0         0 300 i
*i                  192.168.1.85           0         100 300 i
*>  40.1.1.0/24     192.168.1.90           0         0 300 i
*i                  192.168.1.85           0         100 300 i
* > 40.1.2.0/24     192.168.1.90           0         0 300 i
*i                  192.168.1.85           0         100 300 i
*>  40.1.3.0/24     192.168.1.90           0         0 300 i
*i                  192.168.1.85           0         100 300 i
*> 192.168.1.84/30  0.0.0.0                0       32768 i
```

R3#show ip route

```
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

40.0.0.0/24 is subnetted, 4 subnets
B      40.1.1.0 [20/0] via 192.168.1.90, 00:00:01
B      40.1.0.0 [20/0] via 192.168.1.90, 00:00:01
B      40.1.3.0 [20/0] via 192.168.1.90, 00:00:01
B      40.1.2.0 [20/0] via 192.168.1.90, 00:00:01
    10.0.0.0/24 is subnetted, 4 subnets
B      10.1.3.0 [20/0] via 192.168.1.90, 00:05:51
B      10.1.2.0 [20/0] via 192.168.1.90, 00:05:51
B      10.1.1.0 [20/0] via 192.168.1.90, 00:05:51
B      10.1.0.0 [20/0] via 192.168.1.90, 00:05:51
    192.168.1.0/24 is variably subnetted, 3 subnets, 2 masks
C      192.168.1.88/30 is directly connected, Serial1/1
L      192.168.1.89/32 is directly connected, Serial1/1
C      192.168.1.84/30 is directly connected, Serial1/0
L      192.168.1.86/32 is directly connected, Serial1/0
C      192.168.1.48/28 is directly connected, FastEthernet0/0
L      192.168.1.49/28 is directly connected, FastEthernet0/0
    30.0.0.0/24 is subnetted, 4 subnets
C      30.1.3.0 is directly connected, Loopback3
L      30.1.3.1/32 is directly connected, Loopback3
C      30.1.2.0 is directly connected, Loopback2
L      30.1.2.1/32 is directly connected, Loopback2
C      30.1.1.0 is directly connected, Loopback1
L      30.1.1.1/32 is directly connected, Loopback1
C      30.1.0.0 is directly connected, Loopback0
L      30.1.1.1/32 is directly connected, Loopback4
```

R1#traceroute 40.1.0.1

```
Type escape sequence to abort.
```

Tracing the route to 40.1.0.1
1 192.168.1.90 96 msec 36 msec 24 msec

After Configuring Weight
R3# clear ip bgp * soft
R3# show ip bgp
BGP table version is 14, local router ID is 30.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.1.0.0/24	192.168.1.90			0	300 100 i
*> 10.1.1.0/24	192.168.1.90			0	300 100 i
*> 10.1.2.0/24	192.168.1.90			0	300 100 i
*> 10.1.3.0/24	192.168.1.90			0	300 100 i
*> 30.1.0.0/24	0.0.0.0	0		32768	i
*> 30.1.1.0/24	0.0.0.0	0		32768	i
*> 30.1.2.0/24	0.0.0.0	0		32768	i
*> 30.1.3.0/24	0.0.0.0	0		32768	i
* 40.1.0.0/24	192.168.1.90		0	0	300 i
*>i	192.168.1.85	0	45000	100	300 i
* 40.1.1.0/24	192.168.1.90	0		0	300 i
*>i	192.168.1.85	0	45000	100	300 i
* 40.1.2.0/24	192.168.1.90	0		0	300 i
*>i	192.168.1.85	0	45000	100	300 i
* 40.1.3.0/24	192.168.1.90	0		0	300 i
*>i	192.168.1.85	0	45000	100	300 i
*> 192.168.1.84/30	0.0.0.0	0		32768	i

R3 # show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

40.0.0.0/24 is subnetted, 4 subnets
B 40.1.1.0 [200/0] via 192.168.1.85, 00:04:01
B 40.1.0.0 [200/0] via 192.168.1.85, 00:04:01
B 40.1.3.0 [200/0] via 192.168.1.85, 00:04:01
B 40.1.2.0 [200/0] via 192.168.1.85, 00:04:01
10.0.0.0/24 is subnetted, 4 subnets
B 10.1.3.0 [20/0] via 192.168.1.90, 00:04:01
B 10.1.2.0 [20/0] via 192.168.1.90, 00:04:01
B 10.1.1.0 [20/0] via 192.168.1.90, 00:04:01
B 10.1.0.0 [20/0] via 192.168.1.90, 00:04:01
192.168.1.0/24 is variably subnetted, 3 subnets, 2 masks

```
     192.168.1.0/24 is variably subnetted, 3 subnets, 2 masks
C       192.168.1.88/30 is directly connected, Serial1/1
L       192.168.1.89/32 is directly connected, Serial1/1
C       192.168.1.84/30 is directly connected, Serial1/0
L       192.168.1.86/32 is directly connected, Serial1/0
C       192.168.1.48/28 is directly connected, FastEthernet0/0
L       192.168.1.49/28 is directly connected, FastEthernet0/0
     30.0.0.0/24 is subnetted, 4 subnets
C       30.1.3.0 is directly connected, Loopback3
L       30.1.3.1/32 is directly connected, Loopback3
C       30.1.2.0 is directly connected, Loopback2
L       30.1.2.1/32 is directly connected, Loopback2
C       30.1.1.0 is directly connected, Loopback1
L       30.1.1.1/32 is directly connected, Loopback1
C       30.1.0.0 is directly connected, Loopback0
L       30.1.1.1/32 is directly connected, Loopback4
R3#
R1#traceroute 40.1.0.1
Type escape sequence to abort.
Tracing the route to 40.1.0.1

  1 192.168.1.85 4 msec 40 msec 44 msec
  2 192.168.1.81 [AS 100]68 msec 16 msec 48 msec
  3 192.168.1.93 [AS 300]76 msec 12 msec 36 msec
```

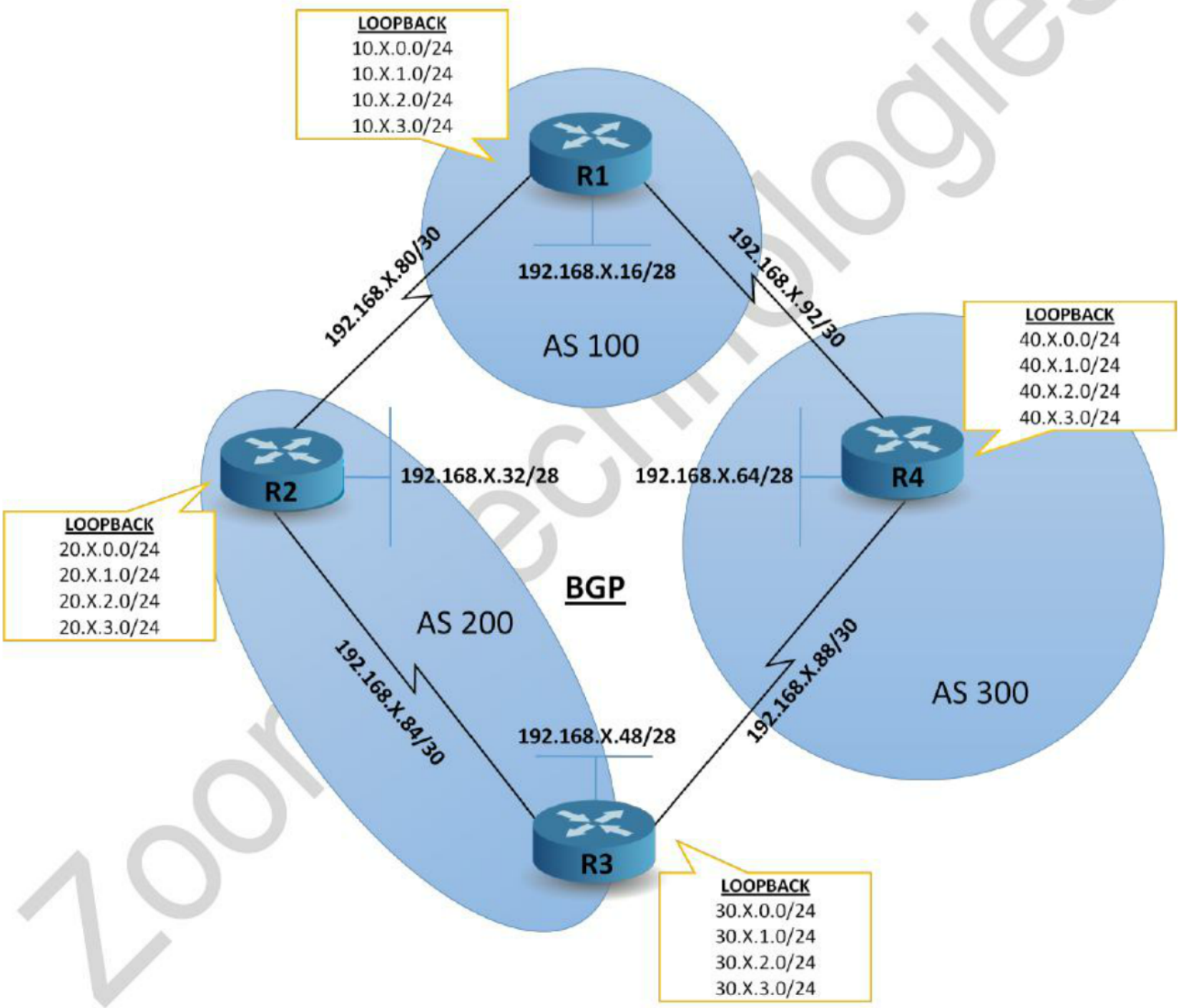
LAB 35: AS PATH PREPEND

OBJECTIVE:

To change the AS PATH BGP attribute to influence which path is used for outbound traffic.

To make packets from R1 to R4's loopback interface go via R2 and R3 , instead of the direct connection , by changing AS PATH.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers as shown in topology
4) Configure a route map on R1 to identify the networks for which the traffic should take a different path (in this case , 40.0.0.0/24 , the loopback network of R4)
5) Change the AS Path on R1 for the route to 40.0.0.0/24 learnt via R4 , so that the path via R2 is chosen.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP in all the routers as done in previous lab
4) Configure route map on R1 to identify the traffic which needs to take a different path and set the as path to higher value.

   R1(config)# access-list 40 permit 40.1.0.0 0.0.255.255
   R1(config)# route-map zoom permit 10
   R1(config-route-map)#match ip address 40
   R1(config-route-map)# set as-path prepend 400 400 400
   R1(config-route-map)#exit

5) Use this route map for a neighbour relationship with R4 , so **that routes via R2 to 40.0.0.0/24 have a lowerAS Path.**

   R1(config)#router bgp 100

   R1(config-router)#neighbor 192.168.X.93 route-map zoom in

VERIFICATION:

➔ **Before Configuring AS PATH PREPEND**

R1# show ip bgp

```
R1#show ip bgp
BGP table version is 18, local router ID is 10.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
```

```
   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.0.0/24      0.0.0.0                  0         32768 i
*> 10.1.1.0/24      0.0.0.0                  0         32768 i
*> 10.1.2.0/24      0.0.0.0                  0         32768 i
*> 10.1.3.0/24      0.0.0.0                  0         32768 i
*  20.1.0.0/24      192.168.1.93             0         300 200 i
*>                  192.168.1.82             0         0 200 i
*  20.1.1.0/24      192.168.1.93                       0 300 200 i
*>                   192.168.1.82            0         0 200 i
*  20.1.2.0/24      192.168.1.93                        0 300 200 i

! output omitted
*  40.1.0.0/24      192.168.1.82             0         200 300 i
*>                   192.168.1.93            0         0 300 i
*  40.1.1.0/24      192.168.1.82             0         200 300 i
*>                   192.168.1.93            0         0 300 i
*  40.1.2.0/24      192.168.1.82             0         200 300 i
*>                  192.168.1.93             0         0 300 i
*  40.1.3.0/24      192.168.1.82             0         200 300 i
*>                  192.168.1.93             0         0 300 i
```

R1 # show ip route

```
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        10.1.0.0/24 is directly connected, Loopback0
L        10.1.0.1/32 is directly connected, Loopback0
C        10.1.1.0/24 is directly connected, Loopback1
L        10.1.1.1/32 is directly connected, Loopback1
C        10.1.2.0/24 is directly connected, Loopback2
L        10.1.2.1/32 is directly connected, Loopback2
C        10.1.3.0/24 is directly connected, Loopback3
L        10.1.3.1/32 is directly connected, Loopback3
      20.0.0.0/24 is subnetted, 4 subnets
B        20.1.0.0 [20/0] via 192.168.1.82, 00:09:30
B        20.1.1.0 [20/0] via 192.168.1.82, 00:09:30
B        20.1.2.0 [20/0] via 192.168.1.82, 00:09:30
B        20.1.3.0 [20/0] via 192.168.1.82, 00:09:30
      30.0.0.0/24 is subnetted, 4 subnets
B        30.1.0.0 [20/0] via 192.168.1.82, 00:08:33
B        30.1.1.0 [20/0] via 192.168.1.82, 00:08:33
B        30.1.2.0 [20/0] via 192.168.1.82, 00:08:33
B        30.1.3.0 [20/0] via 192.168.1.82, 00:08:33
      40.0.0.0/24 is subnetted, 4 subnets
B        40.1.0.0 [20/0] via 192.168.1.93, 00:00:11
B        40.1.1.0 [20/0] via 192.168.1.93, 00:00:11
B        40.1.2.0 [20/0] via 192.168.1.93, 00:00:11
B        40.1.3.0 [20/0] via 192.168.1.93, 00:00:11
      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.16.1.0/30 is directly connected, Serial0/3/1
L        172.16.1.2/32 is directly connected, Serial0/3/1
      192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
```

C 192.168.1.16/28 is directly connected, FastEthernet0/0
L 192.168.1.17/32 is directly connected, FastEthernet0/0
C 192.168.1.80/30 is directly connected, Serial0/1/1
L 192.168.1.81/32 is directly connected, Serial0/1/1
B 192.168.1.84/30 [20/0] via 192.168.1.82, 00:09:30
C 192.168.1.92/30 is directly connected, Serial0/1/0
L 192.168.1.94/32 is directly connected, Serial0/1/0

After Configuring AS PATH PREPEND
R1# clear ip bgp * soft
R1# show ip bgp
R1#show ip bgp
BGP table version is 22, local router ID is 10.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.1.0.0/24	0.0.0.0	0		32768	i
*> 10.1.1.0/24	0.0.0.0	0		32768	i
*> 10.1.2.0/24	0.0.0.0	0		32768	i
*> 10.1.3.0/24	0.0.0.0	0		32768	i
*> 20.1.0.0/24	192.168.1.82	0		0	200 i
*> 20.1.1.0/24	192.168.1.82	0		0	200 i
*> 20.1.2.0/24	192.168.1.82	0		0	200 i
*> 20.1.3.0/24	192.168.1.82	0		0	200 i
*> 30.1.0.0/24	192.168.1.82			0	200 i
*> 30.1.1.0/24	192.168.1.82			0	200 i
*> 30.1.2.0/24	192.168.1.82			0	200 i
*> 30.1.3.0/24	192.168.1.82			0	200 i
*> 40.1.0.0/24	192.168.1.82			0	200 300 i
*	192.168.1.93	0		0	400 400 400 300 i
*> 40.1.1.0/24	192.168.1.82			0	200 300 i
*	192.168.1.93	0		0	400 400 400 300 i
*> 40.1.2.0/24	192.168.1.82			0	200 300 i
*	192.168.1.93	0		0	400 400 400 300 i
*> 40.1.3.0/24	192.168.1.82			0	200 300 i
*	192.168.1.93	0		0	400 400 400 300 i

R1 # show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override
Gateway of last resort is not set
10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 10.1.0.0/24 is directly connected, Loopback0
L 10.1.0.1/32 is directly connected, Loopback0

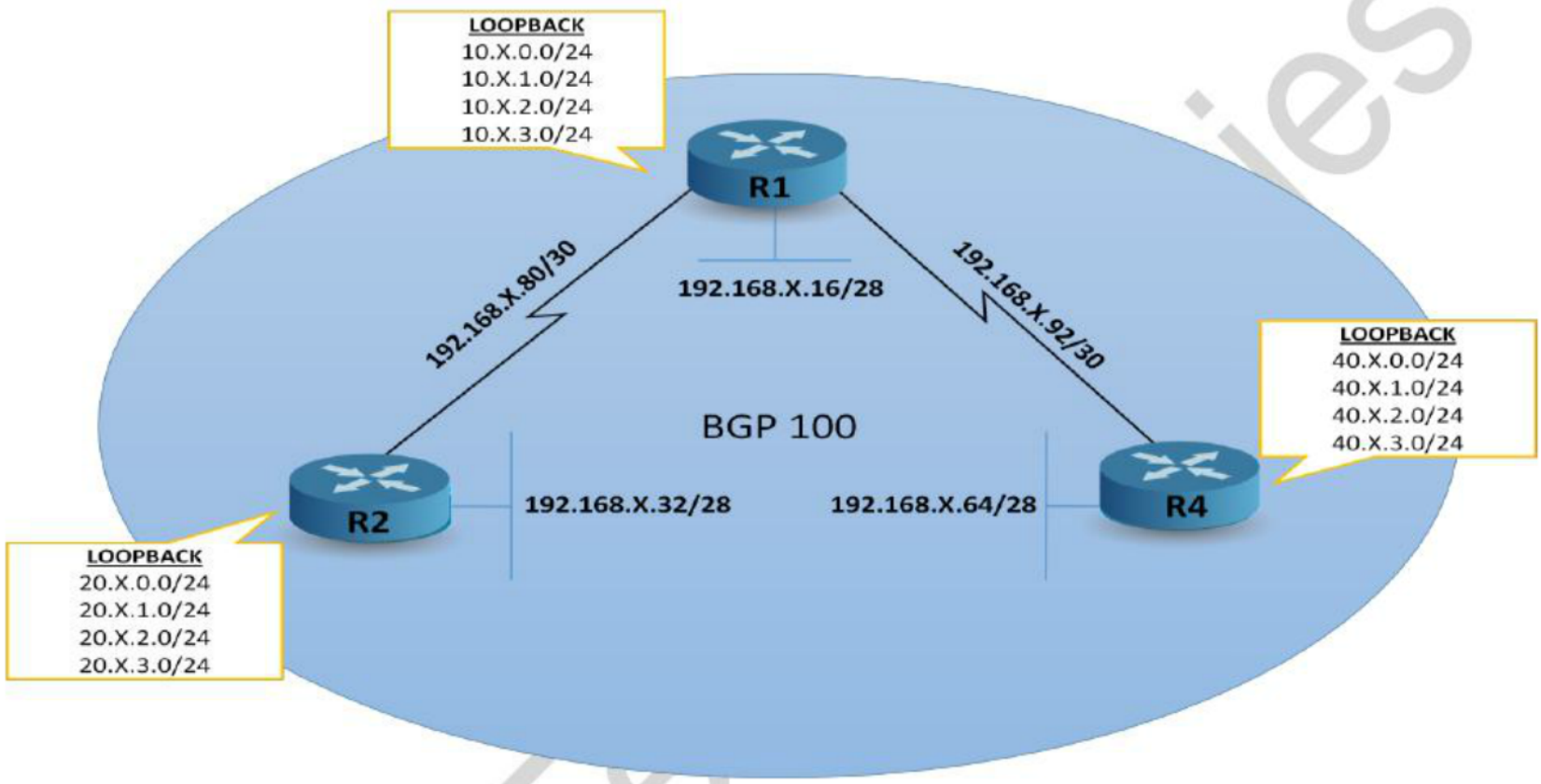
```
C       10.1.1.0/24 is directly connected, Loopback1
L       10.1.1.1/32 is directly connected, Loopback1
C       10.1.2.0/24 is directly connected, Loopback2
L       10.1.2.1/32 is directly connected, Loopback2
C       10.1.3.0/24 is directly connected, Loopback3
L       10.1.3.1/32 is directly connected, Loopback3
    20.0.0.0/24 is subnetted, 4 subnets
B       20.1.0.0 [20/0] via 192.168.1.93, 00:00:01
B       20.1.1.0 [20/0] via 192.168.1.93, 00:00:01
B       20.1.2.0 [20/0] via 192.168.1.93, 00:00:01
B       20.1.3.0 [20/0] via 192.168.1.93, 00:00:01
    30.0.0.0/24 is subnetted, 4 subnets
B       30.1.0.0 [20/0] via 192.168.1.93, 00:00:01
B       30.1.1.0 [20/0] via 192.168.1.93, 00:00:01
B       30.1.2.0 [20/0] via 192.168.1.93, 00:00:01
B       30.1.3.0 [20/0] via 192.168.1.93, 00:00:01
    40.0.0.0/24 is subnetted, 4 subnets
B       40.1.0.0 [20/0] via 192.168.1.82, 00:00:01
B       40.1.1.0 [20/0] via 192.168.1.82, 00:00:01
B       40.1.2.0 [20/0] via 192.168.1.82, 00:00:01
B       40.1.3.0 [20/0] via 192.168.1.82, 00:00:01
    172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/30 is directly connected, Serial0/3/1
L       172.16.1.2/32 is directly connected, Serial0/3/1
    192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C       192.168.1.16/28 is directly connected, FastEthernet0/0
```

LAB 36: BGP SUMMARIZATION

OBJECTIVE:

To configure summarization on R1 router so that 4 loopback addresses are represented by a single BGP entry in routing table.

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers as shown in topology
4) Configure Summarization in all routers.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP in all routers

   R1(config)#router bgp 100
   R1(config-router)#neighbor 192.168.X.82 remote-as 100
   R1(config-router)#neighbor 192.168.X.93 remote-as 100

R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 192.168.X.92 mask 255.255.255.252
R1(config-router)#network 192.168.X.80 mask 255.255.255.252
R1(config-router)#neighbor 192.168.X.82 route-reflector-client
R1(config-router)#neighbor 192.168.X.93 route-reflector-client
R1(config-router)#no synchronization
R1(config-router)#end
R2(config)# router bgp 100
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#network 192.168.X.80 mask 255.255.255.252
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#no synchronization
R2(config-router)#end
R4(config)# router bgp 100
R4(config-router)#neighbor 192.168.X.94 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.92 mask 255.255.255.252
R4(config-router)#no synchronization
R4(config-router)#end

4) Configure Manual Summarization on R1. Summarize the looback interfaces.

R1(conf)# router bgp 100
R1(conf-router)#aggregate-address 10.X.0.0 255.255.252.0 summary-only

VERIFICATION:

➔ **Check the routing table on R4 before summarization**

R4#sh ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/24 is subnetted, 4 subnets
B 10.1.0.0 [200/0] via 192.168.1.94, 00:00:40
B 10.1.1.0 [200/0] via 192.168.1.94, 00:00:40
B 10.1.2.0 [200/0] via 192.168.1.94, 00:00:40
B 10.1.3.0 [200/0] via 192.168.1.94, 00:00:40
40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2

C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
B 192.168.1.80/30 [200/0] via 192.168.1.94, 00:00:40
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0

➔ **After Performing Summarization**

R4#show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override

Gateway of last resort is not set

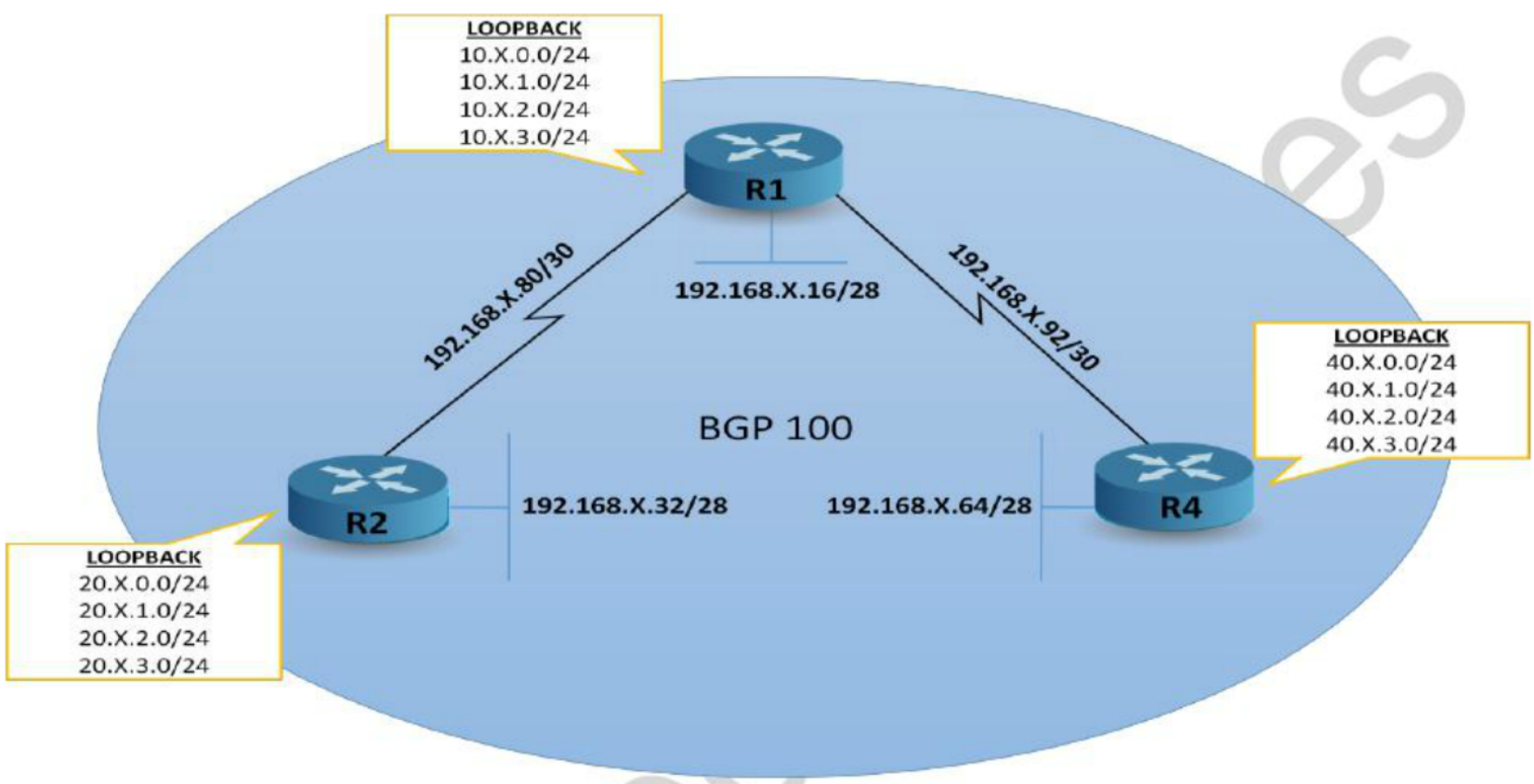
10.0.0.0/22 is subnetted, 1 subnets
B 10.1.0.0 [200/0] via 192.168.1.94, 00:00:04
40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
B 192.168.1.80/30 [200/0] via 192.168.1.94, 00:02:01
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0

LAB 37: BGP AUTHENTICATION

OBJECTIVE:

To configure BGP MD-5 authentication between R1 and R2 routers

TOPOLOGY:



TASK:

1) Verify the interface status in all the routers
2) Check the routing table before configuring BGP on all the routers.
3) Configure BGP in all routers as shown in topology
4) Configure Md-5 Authentication between R1 and R2 routers.

STEPS:

1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

   Router# show ip interface brief

2) Check the routing table on all the routers

   Router# show ip route

3) Configure BGP in all routers as done in previous lab.
4) Configure MD-5 authentication between R1 and R2 routers.

   R1(config)# router bgp 100
   R1(config-router)# neighbor 192.168.X.82 password cisco
   R2(config)# router bgp 100

R2(config-router)# neighbor 192.168.X.81 password cisco

VERIFICATION:

R1#show ip bgp neighbor 192.168.X.82 | i established | md5

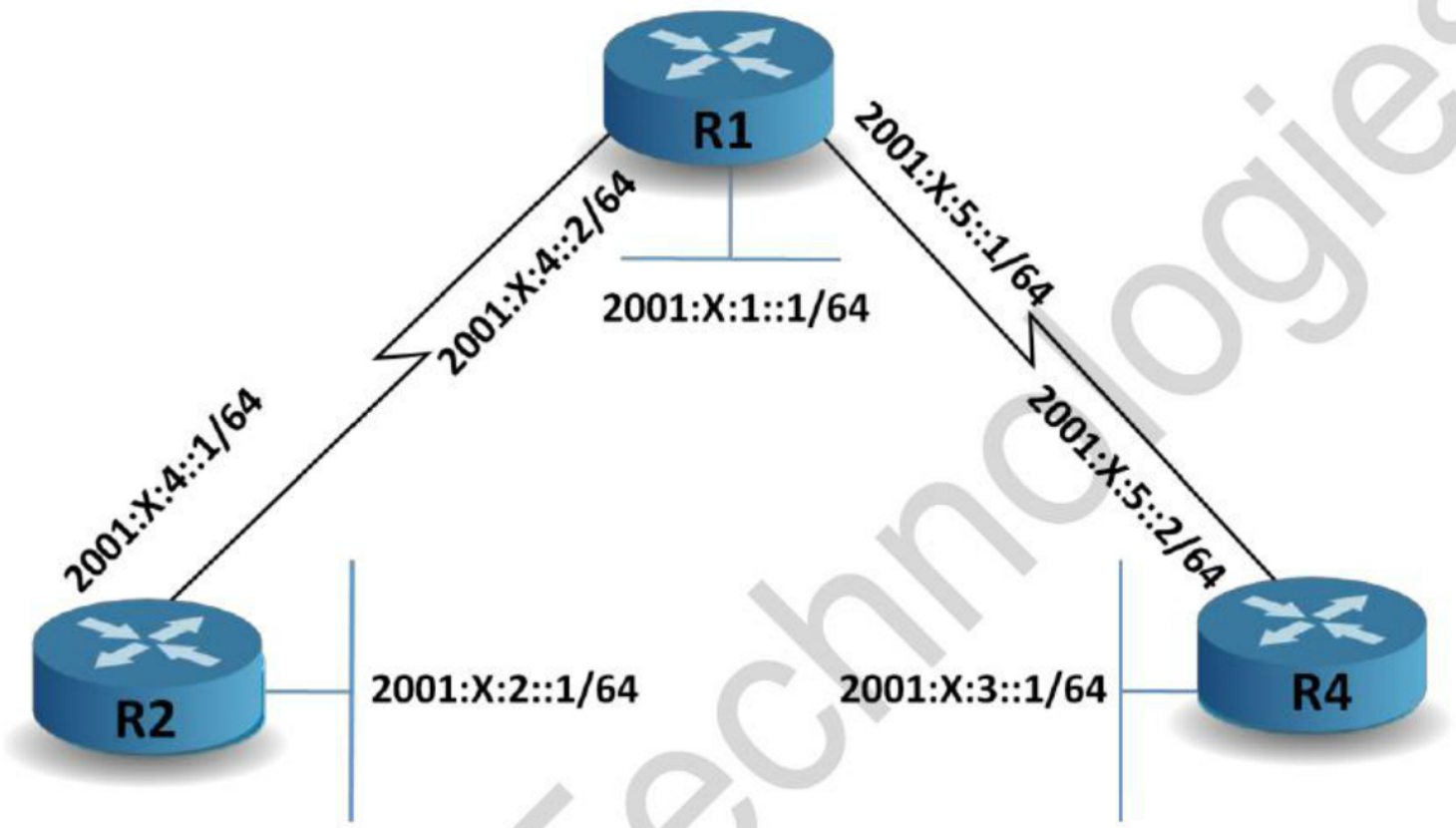
```
Connections established 1; dropped 0
Option Flags: nagle, md5
```

LAB 38: BASIC IPv6 CONFIGURATION

OBJECTIVE:

To configure IPV6 on all routers

TOPOLOGY:



TASK:

1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
2) Verify the configuration using show commands.

STEPS:

1) Verify Serial Interface connectivity by using following command in all routers.

```
Router# show cdp neighbors
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID      Local Intrfce   Holdtme   Capability  Platform  Port ID
P1SW2          Fas 0/0         155       S I   WS-C3560-  Fas 0/5
R2             Ser 0/1/1       129       R S I  2811       Ser 0/0/1
R4             Ser 0/1/0       150       R S I  2811       Ser 0/0/0
```

2) Configure IPV6 addresses on all routers as shown in the topology

```
R1(config)#interface s0/1/1
R1(config-if)#ipv6 address 2001:X:4::2/64
```

```
R1(config-if)# no shutdown
R1(config)#interface s0/1/0
R1(config-if)#ipv6 address 2001:X:5::1/64
R1(config-if)# no shutdown
R1(config)#interface fastethernet0/0
R1(config-if)#ipv6 address 2001:X:1::1/64
R1(config-if)# no shutdown
R2(config)#interface s 0/0/1
R2(config-if)#ipv6 address 2001:X:4::1/64
R2(config-if)# no shutdown
R2(config)#interface fastethernet0/0
R2(config-if)#ipv6 address 2001:X:2::1/64
R2(config-if)# no shutdown
R4(config)#interface s0/0/0
R4(config-if)#ipv6 address 2001:X:5::2/64
R4(config-if)# no shutdown
R4(config)#interface fastethernet0/0
R4(config-if)#ipv6 address 2001:X:3::1/64
R4(config-if)# no shutdown
```

VERIFICATION:

➔ **Verify Interface status in all the routers.**

```
Router# show ipv6 interface brief
R1#show ipv6 interface brief
FastEthernet0/0                [up/up]
    FE80::219:AAFF:FEBA:F590
    2001:1:1::1
FastEthernet0/1                [administratively down/down]
    unassigned
Serial0/1/0                    [up/up]
    FE80::219:AAFF:FEBA:F590
    2001:1:5::1
Serial0/1/1                    [up/up]
    FE80::219:AAFF:FEBA:F590
    2001:1:4::2
Serial0/3/0                    [administratively down/down]
    unassigned
Serial0/3/1                    [administratively down/down]
    unassigned
Loopback0                      [up/up]
    unassigned
Loopback1                      [up/up]
    unassigned
Loopback2                      [up/up]
    unassigned
Loopback3                      [up/up]
Unassigned
```

➔ **Verify Routing Table in all the routers.**

Router # show ipv6 route

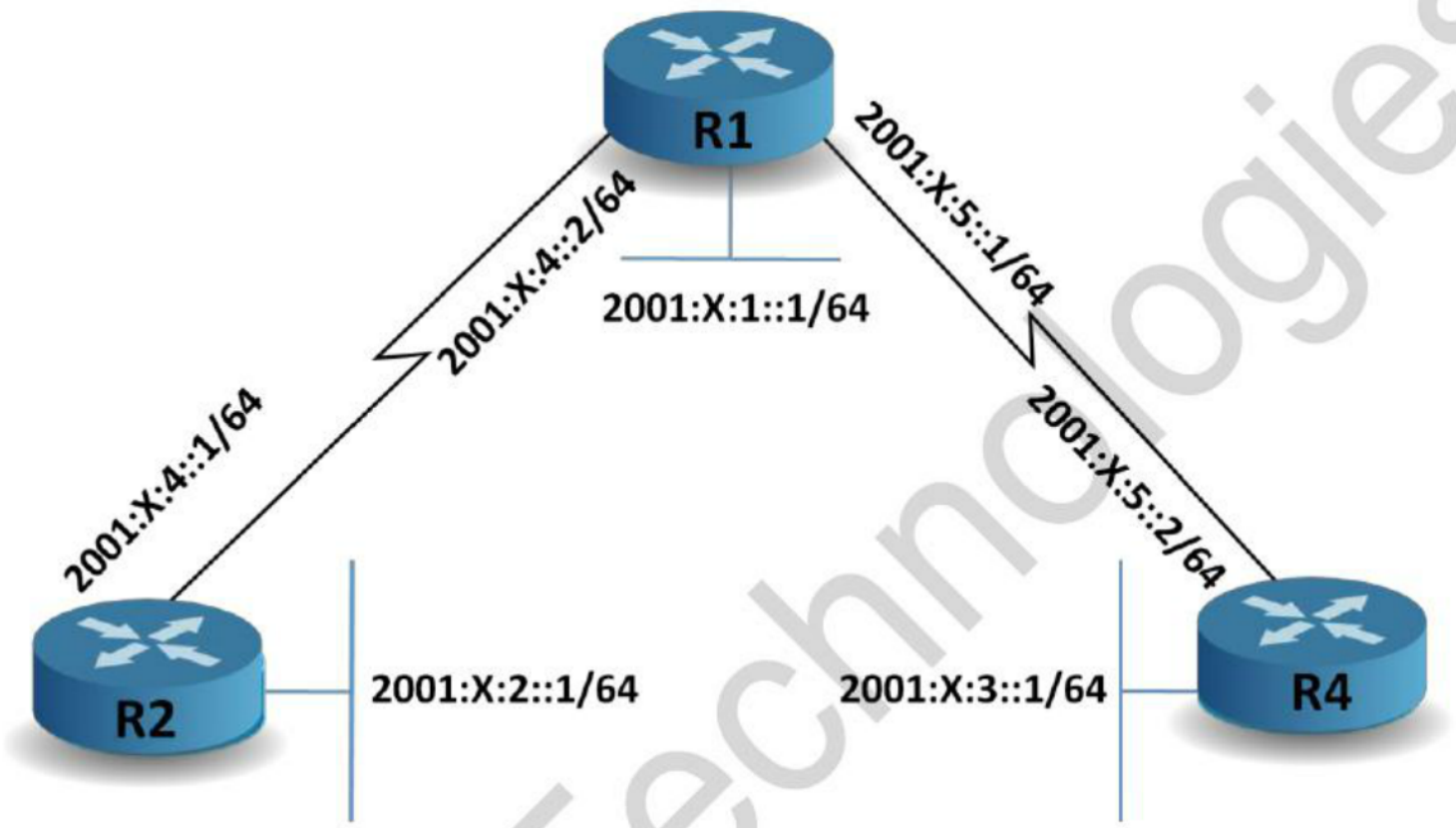
```
R1# show ipv6 route
IPv6 Routing Table - default - 8 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
S   ::/0 [2/0]
     via FE80::219:55FF:FE35:3C29, FastEthernet0/0
C   2001:1:1::/64 [0/0]
     via FastEthernet0/0, directly connected
L   2001:1:1::1/128 [0/0]
     via FastEthernet0/0, receive
C   2001:1:4::/64 [0/0]
     via Serial0/1/1, directly connected
L   2001:1:4::2/128 [0/0]
     via Serial0/1/1, receive
C   2001:1:5::/64 [0/0]
     via Serial0/1/0, directly connected
L   2001:1:5::1/128 [0/0]
     via Serial0/1/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

LAB 39: RIPng

OBJECTIVE:

To configureand verify RIPng on all the routers.

TOPOLOGY:



TASK:

1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
2) Verify the configuration using show commands.
3) Configure and verify RIPng in all routers.

STEPS:

1) Verify Serial Interface connectivity by using following command in all routers.

Router# show cdp neighbors
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560-	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

2) Configure IPV6 addresses on all routers as shown in the topology as in previous lab

3) Configure RIPng in all routers.

R1(config)#no ipv6 unicast-routing
R1(config)#ipv6 unicast-routing
R1(config)# ipv6 router rip zoom
R1(config-router)#exit
R1(config)# interface serial 0/1/1
R1(config-if)#ipv6 rip zoom enable
R1(config)# interface serial 0/1/0
R1(config-if)#ipv6 rip zoom enable
R1(config)# interface fastethernet 0/0
R1(config-if)#ipv6 rip zoom enable
R2(config)#no ipv6 unicast-routing
R2(config)#ipv6 unicast-routing
R2(config)# ipv6 router rip zoom
R2(config-router)#exit
R2(config)# interface serial 0/0/1
R2(config-if)#ipv6 rip zoom enable
R2(config)# interface fastethernet 0/0
R2(config-if)#ipv6 rip zoom enable
R4(config)#no ipv6 unicast-routing
R4(config)#ipv6 unicast-routing
R4(config)# ipv6 router rip zoom
R4(config-router)#exit
R4(config)# interface serial 0/0/0
R4(config-if)#ipv6 rip zoom enable
R4(config)# interface fastethernet 0/0
R4(config-if)#ipv6 rip zoom enable

VERIFICATION:

➔ **Verify routing table in all the routers.**

Router # show ipv6 route

R4# show ipv6 route

```
IPv6 Routing Table - default - 8 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       l - LISP
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
R   2001:1:1::/64 [120/2]
     via FE80::219:AAFF:FEBA:F590, FastEthernet0/0
     via FE80::219:AAFF:FEBA:F590, Serial0/0/0
R   2001:1:2::/64 [120/2]
     via FE80::219:55FF:FE35:3C28, FastEthernet0/0
C   2001:1:3::/64 [0/0]
     via FastEthernet0/0, directly connected
```

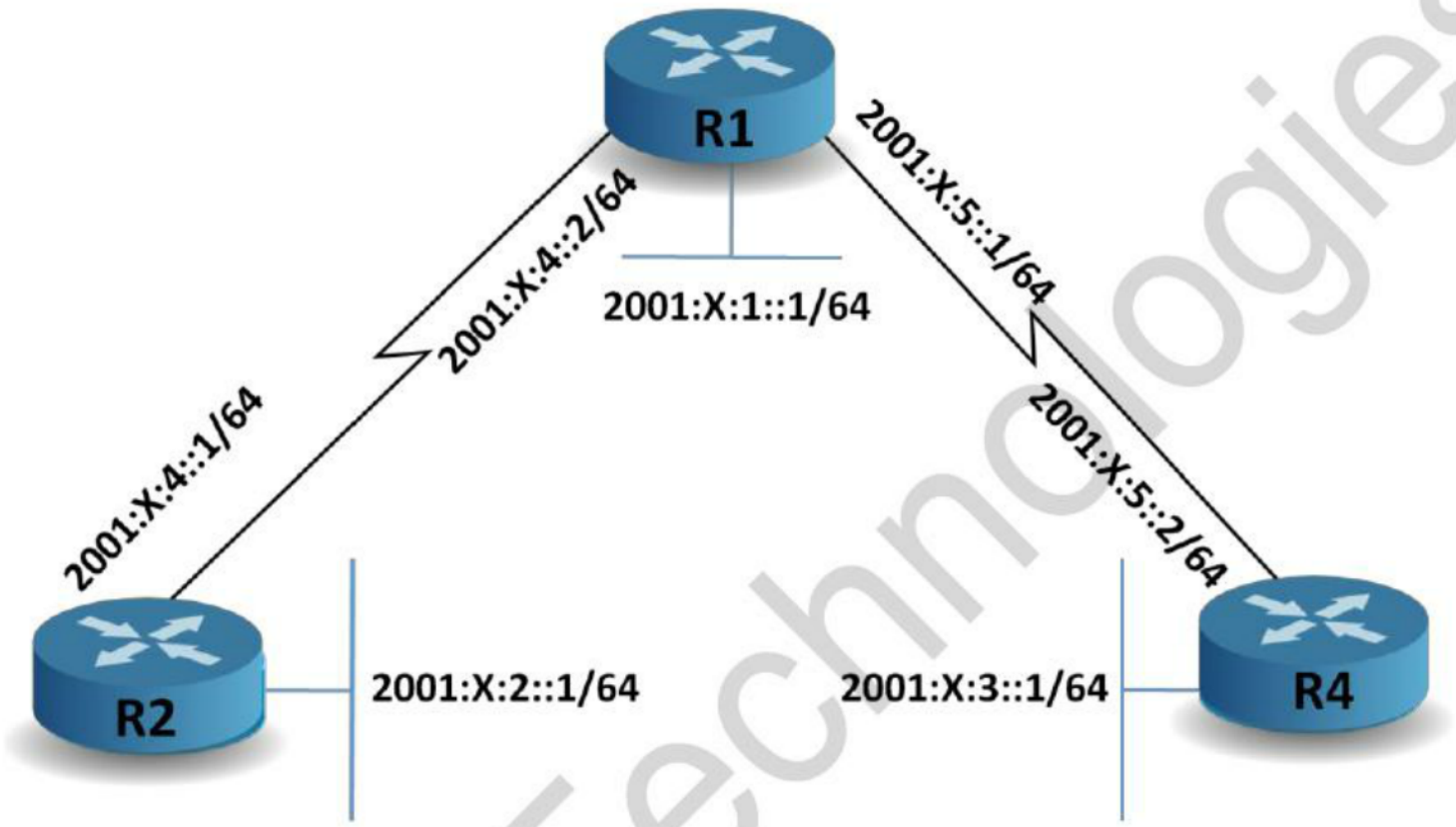
```
L   2001:1:3::1/128 [0/0]
     via FastEthernet0/0, receive
R   2001:1:4::/64 [120/2]
     via FE80::219:55FF:FE35:3C28, FastEthernet0/0
     via FE80::219:AAFF:FEBA:F590, FastEthernet0/0
     via FE80::219:AAFF:FEBA:F590, Serial0/0/0
C   2001:1:5::/64 [0/0]
     via Serial0/0/0, directly connected
L   2001:1:5::2/128 [0/0]
     via Serial0/0/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

LAB 40: EIGRPv6

OBJECTIVE:

To configure and verify EIGRPV6 on all the routers.

TOPOLOGY:



TASK:

1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
2) Verify the configuration using show commands.
3) Configure and verify EIGRPV6 in all routers.

STEPS:

1) Verify Serial Interface connectivity by using following command in all routers.

Router# show cdp neighbors

```
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID      Local Intrfce    Holdtme    Capability  Platform  Port ID
P1SW2          Fas 0/0          155           S I   WS-C3560- Fas 0/5
R2             Ser 0/1/1        129        R S I  2811      Ser 0/0/1
R4             Ser 0/1/0        150        R S I  2811      Ser 0/0/0
```

2) Configure IPV6 addresses on all routers as shown in the topology as in previous lab

3) Configure EIGRPV6 in all routers.

```
R1(config)#no ipv6 unicast-routing
R1(config)#ipv6 unicast-routing
R1(config)# ipv6 router eigrp 100
R1(config-router)#eigrp router-id 1.1.1.1
R1(config-router)#no shutdown
R1(config-router)#exit
R1(config)# interface serial 0/1/1
R1(config-if)#ipv6 eigrp 100
R1(config)# interface serial 0/1/0
R1(config-if)#ipv6 eigrp 100
R1(config)# interface fastethernet 0/0
R1(config-if)#ipv6 eigrp 100
R2(config)#no ipv6 unicast-routing
R2(config)#ipv6 unicast-routing
R2(config)# ipv6 router eigrp 100
R2(config-router)#eigrp router-id 2.2.2.2
R2(config-router)#no shutdown
R2(config-router)#exit
R2(config)# interface serial 0/0/1
R2(config-if)#ipv6 eigrp 100
R2(config)# interface fastethernet 0/0
R2(config-if)#ipv6 eigrp 100
R4(config)#no ipv6 unicast-routing
R4(config)#ipv6 unicast-routing
R4(config)# ipv6 router eigrp 100
R4(config-router)#eigrp router-id 4.4.4.4
R4(config-router)#no shutdown
R4(config-router)#exit
R4(config)# interface serial 0/0/0
R4(config-if)#ipv6 eigrp 100
R4(config)# interface fastethernet 0/0
R4(config-if)#ipv6 eigrp 100
```

VERIFICATION:

➔ **Verify Neighbor table in all the routers.**

Router # show ipv6 eigrp neighbors

```
R4# show ipv6 eigrp neighbors

EIGRP-IPv6 Neighbors for AS(100)
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
1   Link-local address:     Se0/0/0           14 00:00:14    3   200  0  13
    FE80::219:AAFF:FEBA:F590
```

➔ **Verify Topology table in all the routers.**

Router # show ipv6 eigrp topology

```
R4# show ipv6 eigrp topology

EIGRP-IPv6 Topology Table for AS(100)/ID(4.4.4.4)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 2001:1:2::/64, 1 successors, FD is 2174976
        via FE80::219:AAFF:FEBA:F590 (2684416/2172416), Serial0/0/0
P 2001:1:4::/64, 1 successors, FD is 2172416
        via FE80::219:AAFF:FEBA:F590 (2681856/2169856), Serial0/0/0
P 2001:1:5::/64, 1 successors, FD is 2169856
        via Connected, Serial0/0/0
P 2001:1:1::/64, 1 successors, FD is 30720
        via FE80::219:AAFF:FEBA:F590 (2172416/28160), Serial0/0/0
P 2001:1:3::/64, 1 successors, FD is 28160
        via Connected, FastEthernet0/0
```

➔ **Verify Routing table in all the routers.**

Router # show ipv6 route

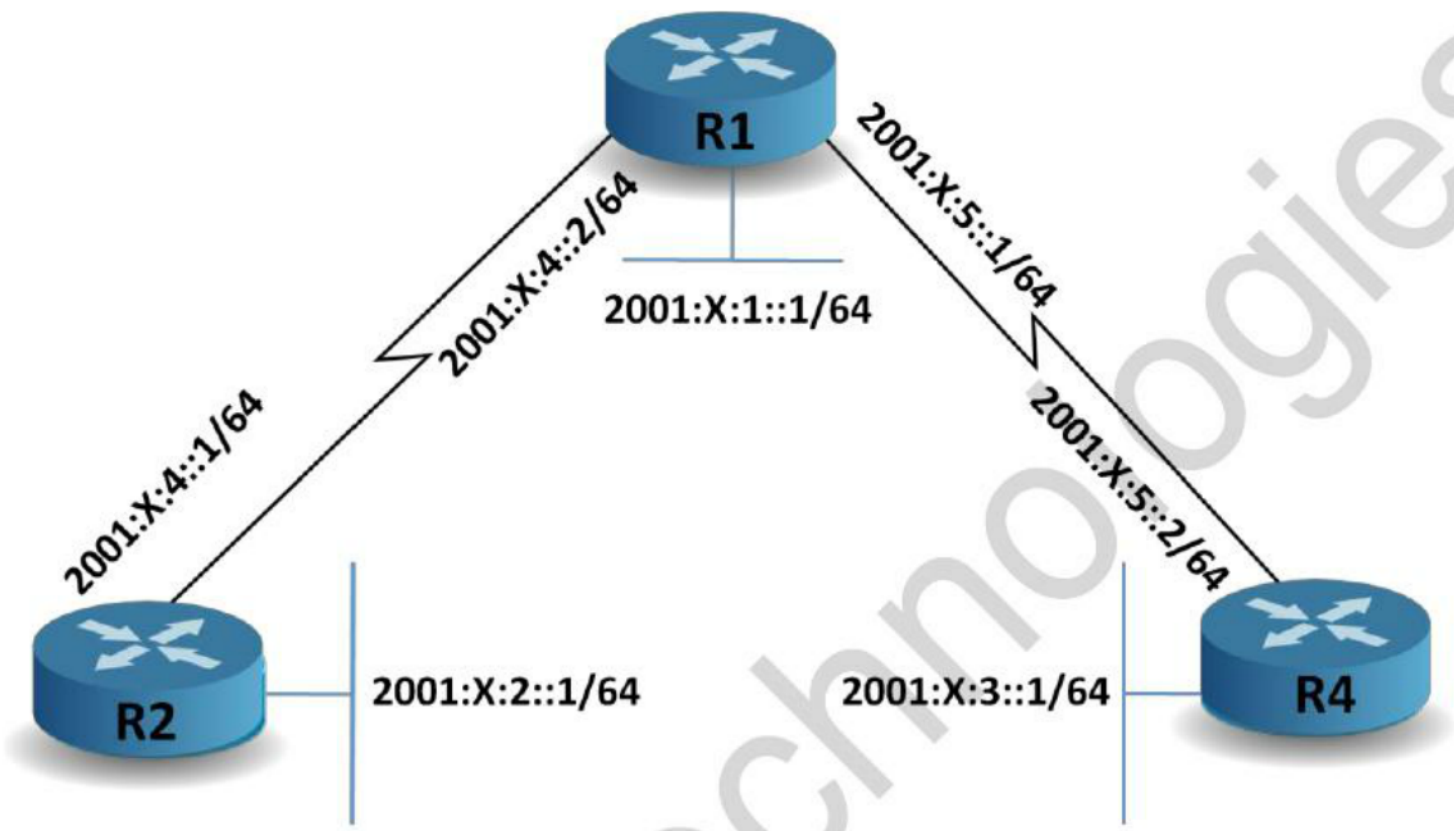
```
R4# show ipv6 route
IPv6 Routing Table - default - 8 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       l - LISP
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D   2001:1:1::/64 [90/2172416]
     via FE80::219:AAFF:FEBA:F590, Serial0/0/0
D   2001:1:2::/64 [90/2684416]
     via FE80::219:AAFF:FEBA:F590, Serial0/0/0
C   2001:1:3::/64 [0/0]
     via FastEthernet0/0, directly connected
L   2001:1:3::1/128 [0/0]
     via FastEthernet0/0, receive
D   2001:1:4::/64 [90/2681856]
     via FE80::219:AAFF:FEBA:F590, Serial0/0/0
C   2001:1:5::/64 [0/0]
     via Serial0/0/0, directly connected
L   2001:1:5::2/128 [0/0]
     via Serial0/0/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

LAB 41: OSPFV3

OBJECTIVE:

To configure and verify OSPFV3 on all the routers.

TOPOLOGY:



TASK:

1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
2) Verify the configuration using show commands.
3) Configure and verify OSPFv3 in all routers.

STEPS:

1) Verify Serial Interface connectivity by using following command in all routers.

Router# show cdp neighbors

```
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID      Local Intrfce    Holdtme    Capability  Platform  Port ID
P1SW2          Fas 0/0          155           S I   WS-C3560- Fas 0/5
R2             Ser 0/1/1        129        R S I  2811      Ser 0/0/1
R4             Ser 0/1/0        150        R S I  2811      Ser 0/0/0
```

2) Configure IPV6 addresses on all routers as in previous lab

3) Configure OSPFV3 in all routers.

```
R1(config)#no ipv6 unicast-routing
R1(config)#ipv6 unicast-routing
R1(config)# ipv6 router ospf 100
R1(config-router)#router-id 1.1.1.1
R1(config-router)#passive-interface fastethernet 0/0
R1(config-router)#exit
R1(config)# interface serial 0/1/1
R1(config-if)#ipv6 ospf 100 area 0
R1(config)# interface serial 0/1/0
R1(config-if)#ipv6 ospf 100 area 0
R1(config)# interface fastethernet 0/0
R1(config-if)#ipv6 ospf 100 area 0
R2(config)#no ipv6 unicast-routing
R2(config)#ipv6 unicast-routing
R2(config)# ipv6 router ospf 100
R2(config-router)#router-id 2.2.2.2
R2(config-router)#passive-interface fastethernet 0/0
R2(config-router)#exit
R2(config)# interface serial 0/0/1
R2(config-if)#ipv6 ospf 100 area 0
R2(config)# interface fastethernet 0/0
R2(config-if)#ipv6 ospf 100 area 0
R4(config)#no ipv6 unicast-routing
R4(config)#ipv6 unicast-routing
R4(config)# ipv6 router ospf 100
R4(config-router)#router-id 4.4.4.4
R4(config-router)#passive-interface fastethernet 0/0
R4(config-router)#exit
R4(config)# interface serial 0/0/0
R4(config-if)#ipv6 ospf 100 area 0
R4(config)# interface fastethernet 0/0
R4(config-if)#ipv6 ospf 100 area 0
```

VERIFICATION:

➔ **Verify Neighbor table in all the routers.**

Router # show ipv6 ospf neighbor

R4# show ipv6 ospf neighbor

Neighbor ID	Pri	State	Dead Time	Interface ID	Interface
1.1.1.1	0	FULL/ -	00:00:36	5	Serial0/0/0

➔ **Verify Database table in all the routers.**

Router # show ipv6 ospf database

R4# show ipv6 ospf database

OSPFv3 Router with ID (4.4.4.4) (Process ID 1)

Router Link States (Area 0)

ADV Router	Age	Seq#	Fragment ID	Link count	Bits
1.1.1.1	91	0x80000003	0	2	None
2.2.2.2	91	0x80000002	0	1	None
4.4.4.4	127	0x80000002	0	1	None

Link (Type-8) Link States (Area 0)

ADV Router	Age	Seq#	Link ID	Interface
1.1.1.1	174	0x80000001	5	Se0/0/0
4.4.4.4	128	0x80000001	5	Se0/0/0
4.4.4.4	138	0x80000001	3	Fa0/0

Intra Area Prefix Link States (Area 0)

ADV Router	Age	Seq#	Link ID	Ref-lstype	Ref-LSID
1.1.1.1	163	0x80000003	0	0x2001	0
2.2.2.2	91	0x80000002	0	0x2001	0

➔ **Verify Routing table in all the routers**

Router # show ipv6 route

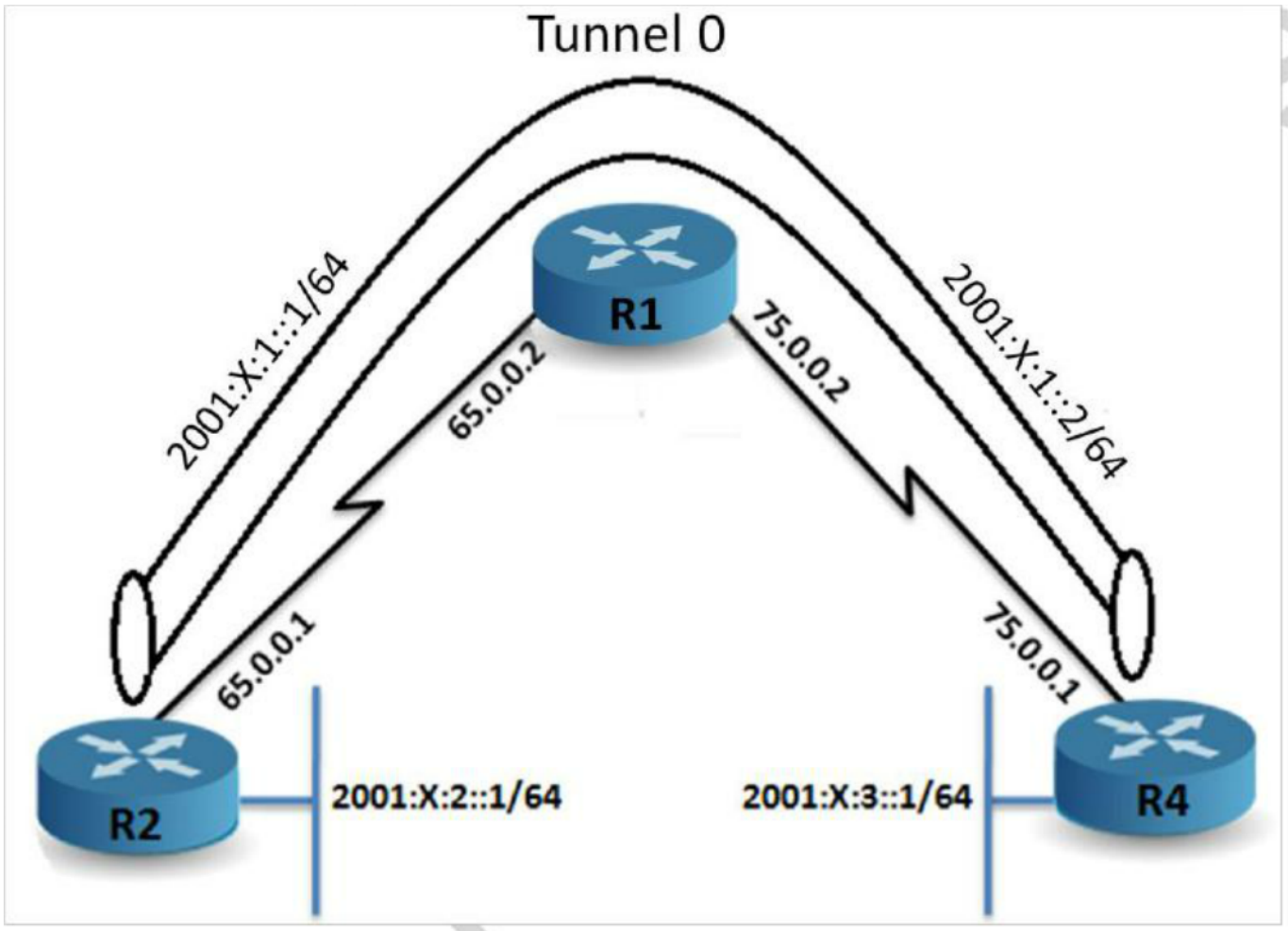
```
R4# show ipv6 route
IPv6 Routing Table - default - 8 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       l - LISP
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
O   2001:1:1::/64 [110/65]
     via FE80::219:AAFF:FEBA:F590, Serial0/0/0
O   2001:1:2::/64 [110/129]
     via FE80::219:AAFF:FEBA:F590, Serial0/0/0
C   2001:1:3::/64 [0/0]
     via FastEthernet0/0, directly connected
L   2001:1:3::1/128 [0/0]
     via FastEthernet0/0, receive
O   2001:1:4::/64 [110/128]
     via FE80::219:AAFF:FEBA:F590, Serial0/0/0
C   2001:1:5::/64 [0/0]
     via Serial0/0/0, directly connected
L   2001:1:5::2/128 [0/0]
     via Serial0/0/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

LAB 42: IPv6- IPv4 TUNNEL

OBJECTIVE:

To configure and verify IPV6 – IPV4 Tunnel

TOPOLOGY:



TASK:

1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
2) Verify the configuration using show commands.
3) Configure and verify IPV6 – IPV4 Tunnel

STEPS:

1) Verify Serial Interface connectivity by using following command in all routers.

   Router# show cdp neighbors

   R1#show cdp neighbors

   Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
   S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
   D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560-	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

2) Configure IPV6 addresses on all routers as in previous lab

3) Configure IPV6 – IPV4 Tunnel in R2 and R4 routers.

```
R2(config)#no ip routing
R2(config)#ip routing
R2(config)#no ipv6 unicast-routing
R2(config)#ipv6 unicast- routing
R2(config)#int tunnel 0
R2(config-if)#ipv6 address 2001:X:1::1/64
R2(config-if)#tunnel mode ipv6ip
R2(config-if)#tunnel source s0/0/1
R2(config-if)#tunnel destination 75.0.0.1
R2(config-if)#exit
R2(config)#ip route 0.0.0.0 0.0.0.0 serial 0/0/1
R2(config)#ipv6 route 2001:X:3::/64 tunnel 0
R2(config)#end
R4(config)#no ip routing
R4(config)#ip routing
R4(config)#no ipv6 unicast-routing
R4(config)#ipv6 unicast- routing
R4(config)#interface tunnel 0
R4(config-if)#ipv6 address 2001:X:1::2/64
R4(config-if)#tunnel mode ipv6ip
R4(config-if)#tunnel source s 0/0/0
R4(config-if)#tunnel destination 65.0.0.1
R4(config-if)#exit
R4(config)#ip route 0.0.0.0 0.0.0.0 se0/0/0
R4(config)#ipv6 route 2001:X:2::/64 tunnel 0
```

VERIFICATION:

➔ **Check Whether tunnel interface is up or not**

R2,R4# show ipv6 interface brief

R2# show ipv6 interface brief

```
FastEthernet0/0          [up/up]
FE80::219:55FF:FE35:3C28
   2001:1:2::1
FastEthernet0/1          [up/up]
   FE80::219:55FF:FE35:3C29
   FC00:2::1
Serial0/0/0              [up/up]
   unassigned
Serial0/0/1              [up/up]
   FE80::219:55FF:FE35:3C28
   2001:1:4::1
Loopback0                [up/up]
```

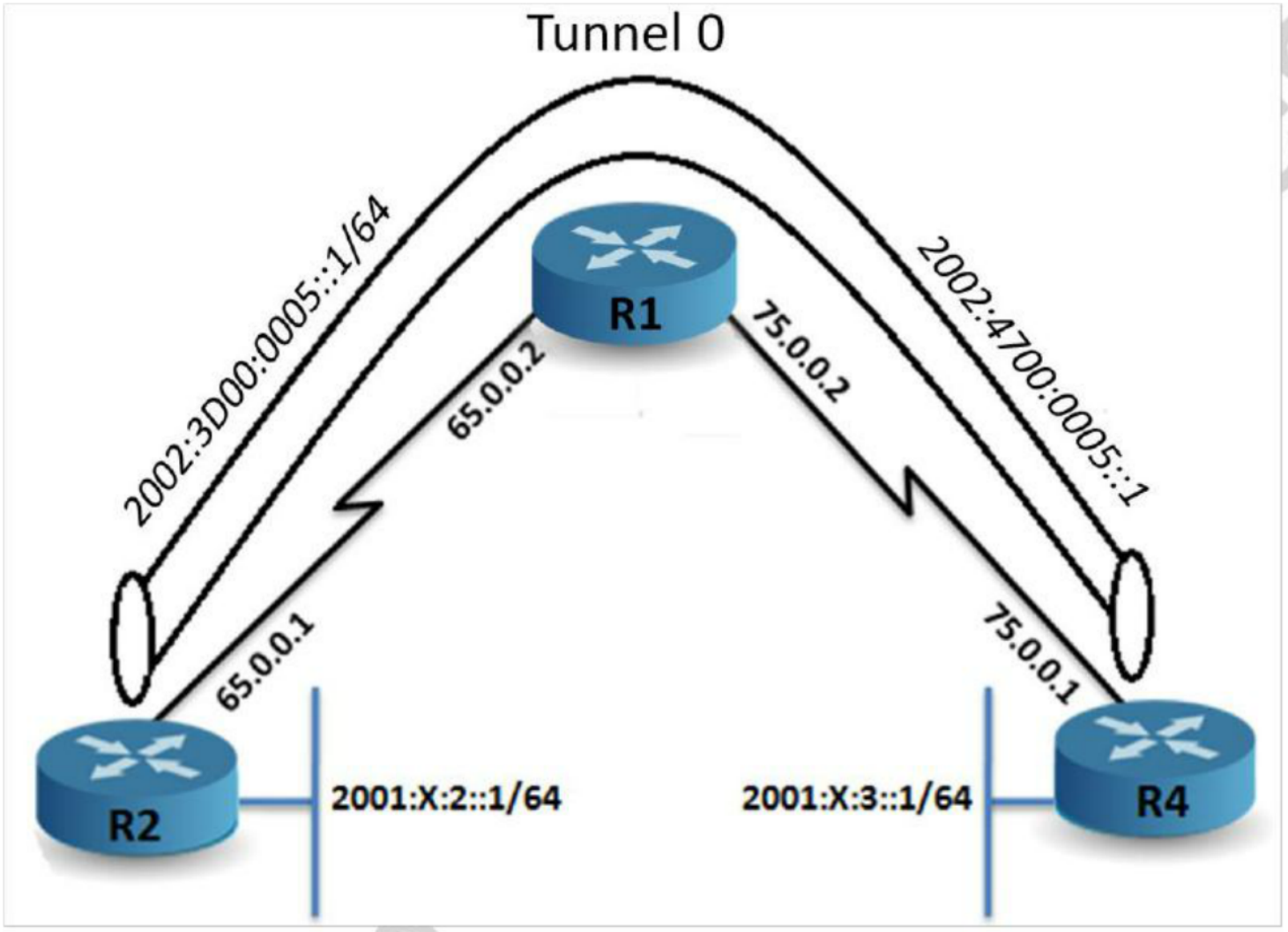
```
   unassigned
Loopback1              [up/up]
   unassigned
Loopback2              [up/up]
   unassigned
Loopback3              [up/up]
   unassigned
Loopback40             [up/up]
   unassigned
Tunnel0                [up/up]
   FE80::4100:1
   2001:1:1::1
```

LAB 43: AUTO IPv6 IPv4 TUNNEL

OBJECTIVE:

To set up and verify Auto IPV6 – IPV4 Tunnel

TOPOLOGY:



TASK:

1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
2) Verify the configuration using show commands.
3) Configure and verify IPV6 – IPV4 Tunnel

STEPS:

1) Verify Serial Interface connectivity by using following command in all routers.

Router# show cdp neighbors
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560	Fas 0/5

R2	**Ser 0/1/1**	**129**	**R S I**	**2811**	**Ser 0/0/1**
R4	**Ser 0/1/0**	**150**	**R S I**	**2811**	**Ser 0/0/0**

2) Configure IPV6 addresses on all routers as shown in the topology as did in previous lab

3) Configure Auto IPV6 – IPV4 Tunnel in R2 and R4 routers.

```
R2(config)#interface tunnel 0
R2(config-if)#ipv6 add 2002:3D00:0005::1/64
R2(config-if)#tunnel mode ipv6ip 6to4
R2(config-if)#tunnel source serial 0/0/1
R2(config-if)#exit
R2(config)#ip route 0.0.0.0 0.0.0.0 s 0/0/1
R2(config)#ipv6 route 2002::/16 tunnel 0
R2(config)#ipv6 route 2001:X:3::/64 tunnel 0
R2(config)#end
R4(config)#int tunnel 0
R4(config-if)#ipv6 add 2002:4700:0005::1/64
R4(config-if)#tunnel mode ipv6ip 6to4
R4(config-if)#tunnel source s0/0/0
R4(config-if)#exit
R4(config)#ip route 0.0.0.0 0.0.0.0 s 0/0/0
R4(config)#ipv6 route 2002::/16 tunnel 0
R4(config)#ipv6 route 2001:X:2::/64 tunnel 0
R4(config)#end
```

VERIFICATION:

➔ **Check Whether tunnel interface is up or not**

R2,R4# show ipv6 interface brief
R4#show ipv6 interface brief

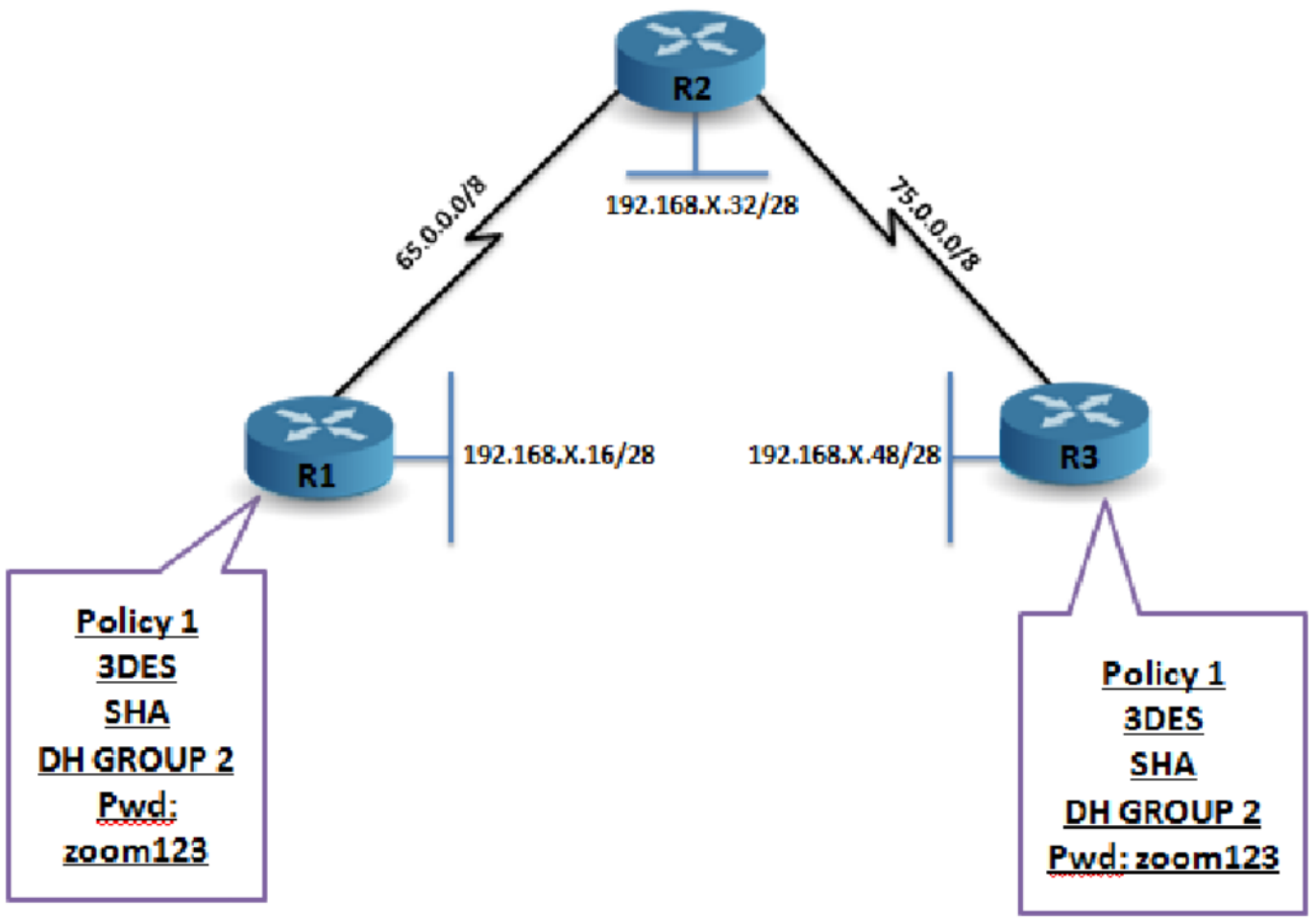
```
FastEthernet0/0          [up/up]
    FE80::21E:7AFF:FE61:6C98
    2001:1:3::1
    2001:13::1
FastEthernet0/1          [administratively down/down]
    unassigned
Serial0/0/0              [up/up]
    FE80::21E:7AFF:FE61:6C98
    2001:1:5::2
Serial0/0/1              [up/up]
    unassigned
Loopback0                [up/up]
    unassigned
Loopback1                [up/up]
    unassigned
Loopback2                [up/up]
    unassigned
Loopback3                [up/up]
    unassigned
Tunnel0                  [up/up]
    FE80::4B00:1
    2002:4700:5::1
```

LAB 44: IPSEC VPN

OBJECTIVE:

To configure a site to site IPSec VPN between R1 and R3 routers

TOPOLOGY:



TASK:

1) Verify connectivity between R1 and R3
2) Create an IPSec tunnel between R1 and R3 with the following parameters:
   - Encryption 3DES
   - Hash SHA
   - DH group 2
   - Tunnel mode
   - Preshared key zoom123
3) Verify the operation of the tunnel

STEPS:

1) Verify Serial Interface connectivity by using following command in all routers.

Router# show cdp neighbors

R1#show cdp neighbors

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

2) Configure IPSEC tunnel

```
R1(config)# interface serial 0/1/1
R1(config-if)#ip address 65.0.0.1 255.0.0.0
R1(config-if)#no shut
R1(config-if)#exit
R1(config)#ip route 0.0.0.0 0.0.0.0 serial 0/1/1
R1(config)#crypto isakmp policy 1
R1(config-isakmp)#authentication pre-share
R1(config-isakmp)#encryption 3des
R1(config-isakmp)#hash sha
R1(config-isakmp)#group 2
R1(config-isakmp)#exit
R1(config)#crypto isakmp key zoom123 address 75.0.0.1
R1(config)#crypto ipsec transform-set zoom esp-des esp-sha-hmac
R1(config-crypto-trans)#mode tunnel
R1(config-crypto-trans)#exit
R1(config)#access-list 100 permit ip 192.168.X.16 0.0.0.15 192.168.X.48 0.0.0.15
R1(config)#crypto map vpnmap 10 ipsec-isakmp
R1(config-crypto-map)#match address 100
R1(config-crypto-map)#set transform-set zoom
R1(config-crypto-map)#set peer 75.0.0.1
R1(config)# interface serial 0/1/1
R1(config-if)#crypto map vpnmap
R3(config)# interface serial 0/1/0
R3(config-if)#ip add 75.0.0.1 255.255.255.0
R3(config-if)#no shut
R3(config)#exit
R3(config)#ip route 0.0.0.0 0.0.0.0 s0/1/0
R3(config)#crypto isakmp policy 1
R3(config-isakmp)#authentication pre-share
R3(config-isakmp)#encryption 3des
R3(config-isakmp)#hash sha
R3(config-isakmp)#group 2
R3(config-isakmp)#exit
R3(config)#crypto isakmp key zoom123 address 65.0.0.1
```

R3(config)#crypto ipsec transform-set zoom esp-des esp-sha-hmac
R3(config-crypto-trans)#mode tunnel
R3(config-crypto-trans)#exit
R3(config)#access-list 100 permit ip 192.168.X.48 0.0.0.15 192.168.X.16 0.0.0.15
R3(config)#crypto map vpnmap 10 ipsec-isakmp
R3(config-crypto-map)#match address 100
R3(config-crypto-map)#set transform-set zoom
R3(config-crypto-map)#set peer 65.0.0.1
R3(config)#interface serial 0/1/0
R3(config-if)crypto map vpnmap
R3(config-if)#exit

3) Configure the IP address on the middle router with appropriate ip addresses.

R2(config)#interface serial 0/1/0
R2(config-if)#ip address 65.0.0.2 255.0.0.0
R2(config-if)#no shut
R2(config)#interface serial 0/1/1
R2(config-if)#ip address 75.0.0.2 255.0.0.0
R2(config-if)#no shut
R2(config-if)#exit
R2(config)#no ip routing
R2(config-if)#ip routing

VERIFICATION:

➔ **Initiate some interesting traffic by using extended ping command from one of the routers to other router.**

R1#ping [Enter]
Protocol [ip]:
Target IP address:192.168.X.49
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 192.168.X.17
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.X.49, timeout is 2 seconds:
.!!!!

Enable debugging for the IPSec tunnel
R1# show crypto ipsec sa
interface: Serial1/1

Crypto map tag: vpntomal, local addr 75.0.0.1
protected vrf: (none)

local ident (addr/mask/prot/port): (192.168.1.16/255.255.255.240/0/0)
remote ident (addr/mask/prot/port): (192.168.1.48/255.255.255.0/0/0)
current_peer 65.0.0.1 port 500
PERMIT, flags={origin_is_acl,ipsec_sa_request_sent}
#pkts encaps: 4, #pkts encrypt: 4, #pkts digest: 4
#pkts decaps: 4, #pkts decrypt: 4, #pkts verify: 4
% OUTPUT OMITTED

R1#show crypto isakmp sa
IPv4 Crypto ISAKMP SA
dst src state conn-id slot status
65.0.0.1 75.0.0.1 QM_IDLE 1001 0 ACTIVE
R1# debug crypto isakmp
00:01:16: ISAKMP:(0): SA request profile is (NULL)
00:01:16: ISAKMP: Created a peer struct for 65.0.0.1, peer port 500
00:01:16: ISAKMP: New peer created peer = 0x672E34D0 peer_handle = 0x80000002
00:01:16: ISAKMP: Locking peer struct 0x672E34D0, refcount 1 for isakmp_initiator
00:01:16: ISAKMP: local port 500, remote port 500
00:01:16: ISAKMP: set new node 0 to QM_IDLE
00:01:16: insert sa successfully sa = 672E275C
00:01:16: ISAKMP:(0):Can not start Aggressive mode, trying Main mode.
00:01:16: ISAKMP:(0):found peer pre-shared key matching 65.0.0.1
00:01:16: ISAKMP:(0): constructed NAT-T vendor-07 ID
00:01:16: ISAKMP:(0): constructed NAT-T vendor-03 ID
00:01:16: ISAKMP:(0): constructed NAT-T vendor-02 ID
00:01:16: ISAKMP:(0):Input = IKE_MESG_FROM_IPSEC, IKE_SA_REQ_MM
00:01:16: ISAKMP:(0):Old State = IKE_READY New State = IKE_I_MM1

00:01:16: ISAKMP:(0): beginning Main Mode exchange
00:01:16: ISAKMP:(0): sending packet to 65.0.0.1 my_port 500 peer_port 500 (I) MM_NO_STATE
00:01:17: ISAKMP (0:0): received packet from 65.0.0.1 dport 500 sport 500 Global (I)
MM_NO_STATE
00:01:17: ISAKMP:(0):Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
00:01:17: ISAKMP:(0):Old State = IKE_I_MM1 New State = IKE_I_MM2

00:01:17: ISAKMP:(0): processing SA payload. message ID = 0
00:01:17: ISAKMP:(0): processing vendor id payload
00:01:17: ISAKMP:(0): vendor ID seems Unity/DPD but major 245 mismatch
00:01:17: ISAKMP (0:0): vendor ID is NAT-T v7
00:01:17: ISAKMP:(0):found peer pre-shared key matching 65.0.0.1
00:01:17: ISAKMP:(0): local preshared key found
00:01:17: ISAKMP : Scanning profiles for xauth ...
00:01:17: ISAKMP:(0):Checking ISAKMP transform 1 against priority 10 policy
00:01:17: ISAKMP: encryption 3DES-CBC
00:01:17: ISAKMP: hash SHA
00:01:17: ISAKMP: default group 2
00:01:17: ISAKMP: auth pre-share
00:01:17: ISAKMP: life type in seconds
00:01:17: ISAKMP: life duration (VPI) of 0x0 0x1 0x51 0x80
INDIA#AKMP:(0):atts are acceptable. Next payload is 0
00:01:17: ISAKMP:(0): processing vendor id payload

```
00:01:17: ISAKMP:(0): vendor ID seems Unity/DPD but major 245 mismatch
00:01:17: ISAKMP (0:0): vendor ID is NAT-T v7
00:01:17: ISAKMP:(0):Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
00:01:17: ISAKMP:(0):Old State = IKE_I_MM2  New State = IKE_I_MM2

00:01:17: ISAKMP:(0): sending packet to 65.0.0.1 my_port 500 peer_port 500 (I) MM_SA_SETUP
00:01:17: ISAKMP:(0):Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
00:01:17: ISAKMP:(0):Old State = IKE_I_MM2  New State = IKE_I_MM3

00:01:17: ISAKMP (0:0): received packet from 65.0.0.1 dport 500 sport 500 Global (I)
MM_SA_SETUP
00:01:17: ISAKMP:(0):Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
00:01:17: ISAKMP:(0):Old State = IKE_I_MM3  New State = IKE_I_MM4

00:01:17: ISAKMP:(0): processing KE payload. message ID = 0
00:01:17: ISAKMP:(0): processing NONCE payload. message ID = 0
00:01:17: ISAKMP:(0):found peer pre-shared key matching 65.0.0.1
00:01:17: ISAKMP:(1001): processing vendor id payload
00:01:17: ISAKMP:(1001): vendor ID is Unity
00:01:17: ISAKMP:(1001): processing vendor id payload
00:01:17: ISAKMP:(1001): vendor ID is DPD
00:01:17: ISAKMP:(1001): processing vendor id payload
00:01:17: ISAKM
INDIA#P:(1001): speaking to another IOS box!
00:01:17: ISAKMP:(1001):Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
00:01:17: ISAKMP:(1001):Old State = IKE_I_MM4  New State = IKE_I_MM4

00:01:17: ISAKMP:(1001):Send initial contact
00:01:17: ISAKMP:(1001):SA is doing pre-shared key authentication using id type ID_IPV4_ADDR
00:01:17: ISAKMP (0:1001): ID payload
        next-payload : 8
        type         : 1
        address      : 75.0.0.1
        protocol     : 17
        port         : 500
        length       : 12
00:01:17: ISAKMP:(1001):Total payload length: 12
00:01:17: ISAKMP:(1001): sending packet to 65.0.0.1 my_port 500 peer_port 500 (I)
MM_KEY_EXCH
00:01:17: ISAKMP:(1001):Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
00:01:17: ISAKMP:(1001):Old State = IKE_I_MM4  New State = IKE_I_MM5
00:01:17: ISAKMP (0:1001): received packet from 65.0.0.1 dport 500 sport 500 Global (I)
MM_KEY_EXCH
00:01:17: ISAKMP:(1001): processing ID payload. message ID = 0
00:01:17: ISAKMP (0:1001): ID payload
        next-payload : 8
        type         : 1
        address      : 65.0.0.1
        protocol     : 17
        port         : 500
        length       : 12
```

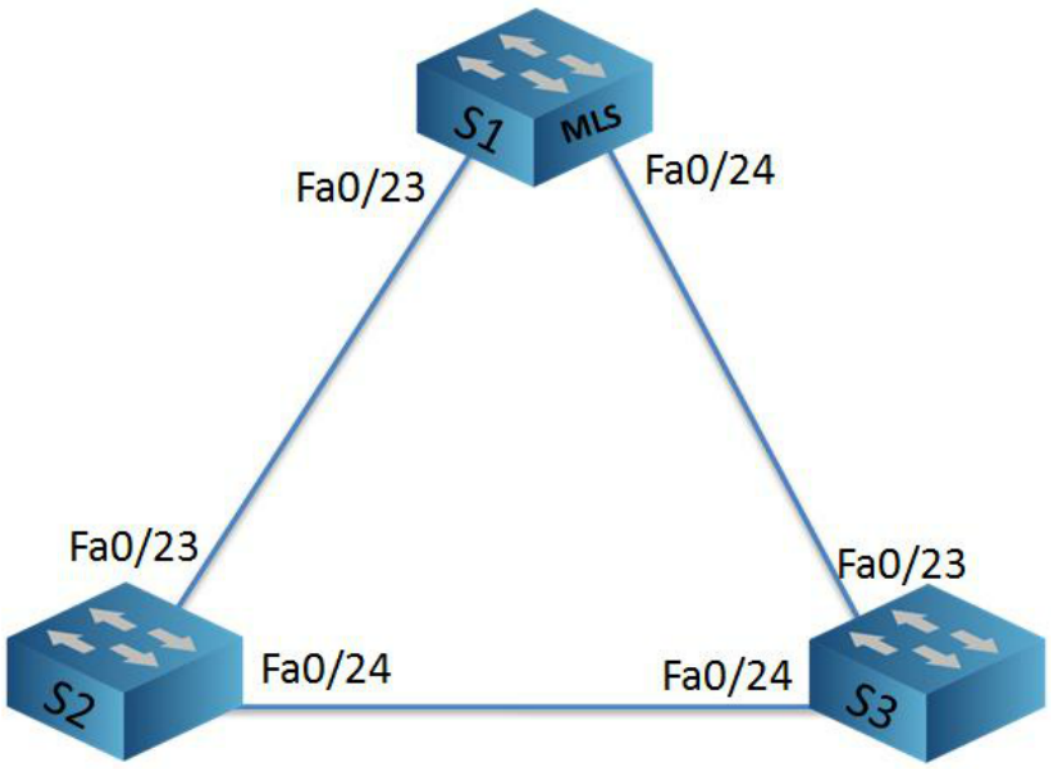
```
00:01:17: ISAKMP:(0):: peer matches *
INDIA#none* of the profiles
00:01:17: ISAKMP:(1001): processing HASH payload. message ID = 0
00:01:17: ISAKMP:(1001):SA authentication status:
        authenticated
```

LAB 1: VLAN

OBJECTIVE:

To configure VLANs in a switched network.

TOPOLOGY:



TASK:

1) Configure the following VLANs on all the switches.
   I. VLAN 10 – CCNA
   II. VLAN 20--- CCNP
   III. VLAN 30------CCIE
2) Configure the interface between the switches as Trunk interfaces.
3) Assign the VLANs to the some of the interfaces of the Switch.

STEPS:

1) Configure VLAN 10, 20, 30 in all the switches.

```
SW1(config)# VLAN 10
SW1(config-VLAN)#name CCNA
SW1(config)# VLAN 20
SW1(config-VLAN)#name CCNP
SW1(config)# VLAN 30
SW1(config-VLAN)#name CCIE
SW2(config)# VLAN 10
SW2(config-VLAN)#name CCNA
```

```
SW2(config)# VLAN 20
SW2(config-VLAN)#name CCNP
SW2(config)# VLAN 30
SW2(config-VLAN)#name CCIE
SW3(config)# VLAN 10
SW3(config-VLAN)#name CCNA
SW3(config)# VLAN 20
SW3(config-VLAN)#name CCNP
SW3(config)# VLAN 30
SW3(config-VLAN)#name CCIE
```

2) Assign VLANs to the interfaces in all switches.

```
SW(config)#interface fastethernet 0/10
SW(config-if)#switchport mode access
SW(config-if)#switchport access VLAN 10
SW(config)#interface fastethernet 0/12
SW(config-if)#switchport mode access
SW(config-if)#switchport access VLAN 20
SW(config)#interface fastethernet 0/15
SW(config-if)#switchport mode access
SW(config-if)#switchport access VLAN 30
```

3) Configure the ports connected to other switches as Trunks

```
SW1(config)#interface range fastethernet 0/23 – 24
SW1(config)#switchport mode trunk
SW2(config)#interface range fastethernet 0/23 – 24
SW2(config)#switchport mode trunk
SW3(config)#interface range fastethernet 0/23 – 24
SW3(config)#switchport mode trunk
```

VERIFICATION:

➔ **Verify VLAN database in all the switches.**

SW3#show VLAN

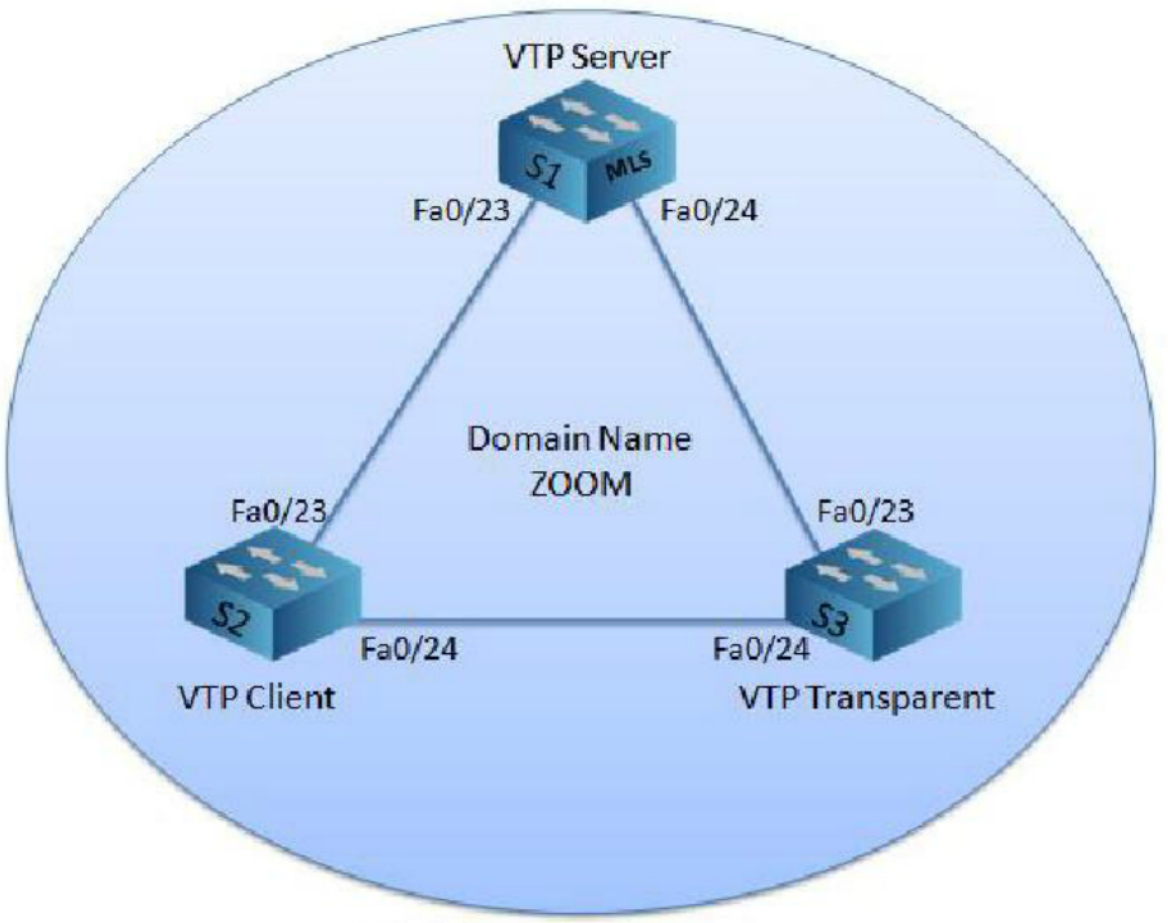
VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/11, Fa0/14, Fa0/16 Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22 Gi0/1, Gi0/2
10	ccna	active	Fa0/10
20	ccnp	active	Fa0/12
30	ccie	active	Fa0/15
1002	fddi-default	act/unsup	
1003	trcrf-default	act/unsup	
1004	fddinet-default	act/unsup	
1005	trbrf-default	act/unsup	

LAB 2: VTP CONFIGURATION

OBJECTIVE:

To configure VTP (VLAN trunking protocol) in a switched network to automate the creation of VLANs

TOPOLOGY:



TASK:

1) Configure the interface between the switches as Trunk interfaces.
2) Configure VTP domain Zoom in all switches
3) Make SW1 as Server, SW2 as Client and SW3 as Transparent switch
4) Create VLANs on SW1 and verify that these VLANs are learnt by SW2

STEPS:

1) Configure trunk interfaces between the switches as in the previous lab.
2) Configure VTP domain name as Zoom in all switches

   SW1(config)# VTP domain zoom
   SW2(config)# VTP domain zoom
   SW3(config)# VTP domain zoom

3) Configure switch 1 as server, switch 2 as client and switch 3 as transparent.

   SW1(config)#VTP mode server
   SW2(config)# VTP mode client
   SW3(config)#VTP mode transparent

4) Configure VLANs in server switch as in previous lab

VERIFICATION:

SW1#show vtp status

```
VTP Version                     : running VTP2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 8
VTP Operating Mode              : Server
VTP Domain Name                 : zoom
VTP Pruning Mode                : Enabled
VTP V2 Mode                     : Enabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xE0 0x04 0x0D 0x7F 0x89 0xA0 0xC7 0xE8
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
Local updater ID is 192.168.0.11 on interface Vl1 (lowest numbered VLAN interface found)
```

SW1#show VLAN

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                 Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                 Fa0/9, Fa0/11, Fa0/14, Fa0/16
                                                 Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                 Fa0/21, Fa0/22, Gi0/1, Gi0/2
10   ccna                              active    Fa0/10
20   ccnp                              active    Fa0/12
30   ccie                              active    Fa0/15
1002 fddi-default                      act/unsup
1003 trcrf-default                     act/unsup
1004 fddinet-default                   act/unsup
1005 trbrf-default                     act/unsup
```

SW2#show vtp status

```
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 64
Number of existing VLANs        : 8
VTP Operating Mode              : Client
VTP Domain Name                 : zoom
VTP Pruning Mode                : Enabled
VTP V2 Mode                     : Enabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xE0 0x04 0x0D 0x7F 0x89 0xA0 0xC7 0xE8
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
```

SW2#show VLAN

VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/11, Fa0/13, Fa0/14 Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20, Fa0/21, Fa0/22
10	ccna	active	Fa0/10
20	ccnp	active	Fa0/12
30	ccie	active	Fa0/15
1002	fddi-default	act/unsup	
1003	trcrf-default	act/unsup	
1004	fddinet-default	act/unsup	
1005	trbrf-default	act/unsup	

SW3#show vtp status

```
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 128
Number of existing VLANs        : 8
VTP Operating Mode              : Transparent
VTP Domain Name                 : zoom
VTP Pruning Mode                : Enabled
VTP V2 Mode                     : Enabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xE0 0x04 0x0D 0x7F 0x89 0xA0 0xC7 0xE8
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
```

SW3#show VLAN

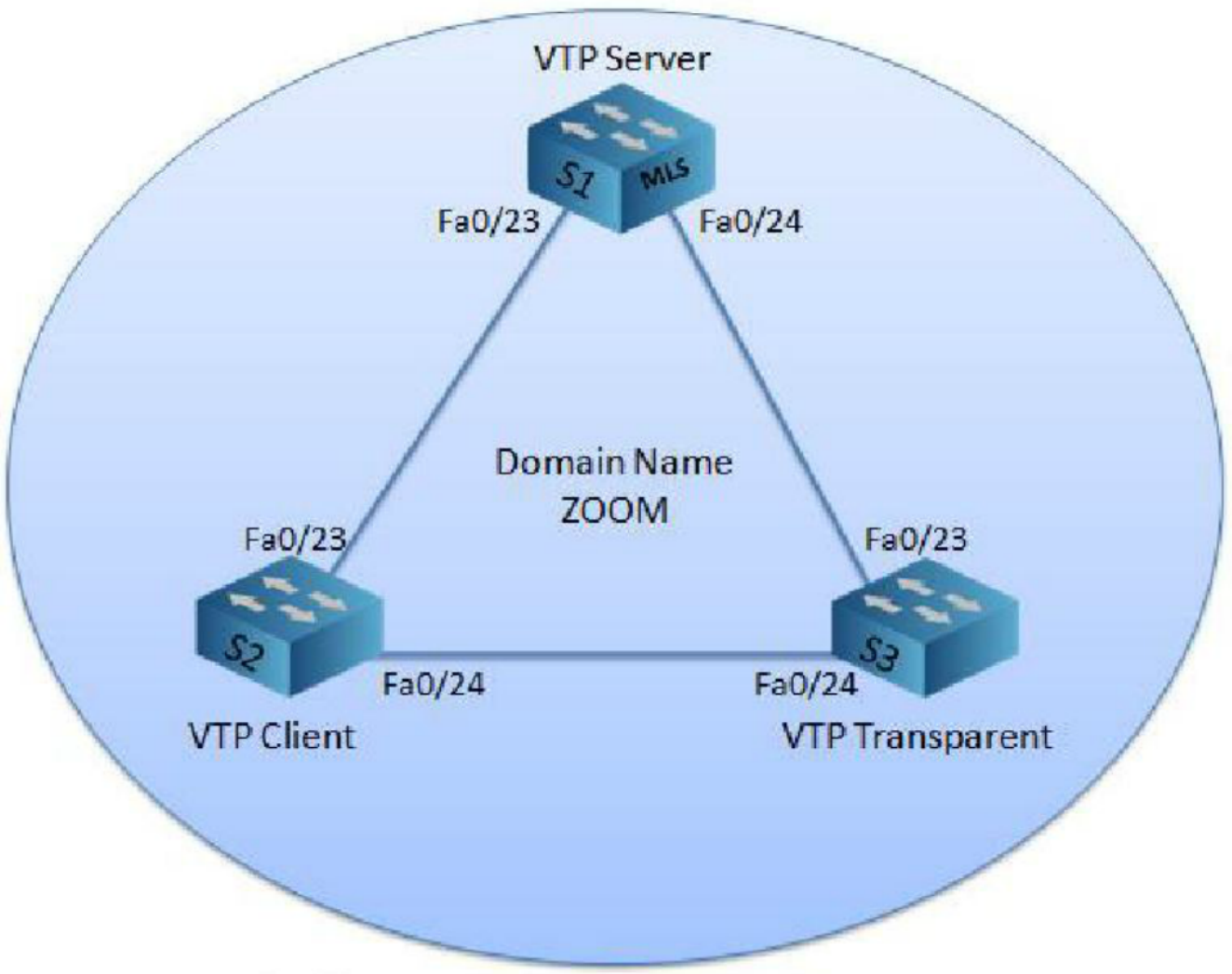
VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/11, Fa0/13, Fa0/14 Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20, Fa0/21, Fa0/22
10	ccna	active	Fa0/10
20	ccnp	active	Fa0/12
30	ccie	active	Fa0/15
1002	fddi-default	act/unsup	
1003	trcrf-default	act/unsup	
1004	fddinet-default	act/unsup	
1005	trbrf-default	act/unsup	

LAB 3: VTP ADVANCED

OBJECTIVE:

To configure VTP version 2 in all switches and avoid unnecessary flooding of VLAN traffic, on the trunk links

TOPOLOGY:



TASK:

1) Find out VTP version on all switches.
2) Enable VTP version 2 in all switches.
3) Configure VTP password as zoom in all switches.
4) Configure VTP in such a way that no unnecessary VLAN traffic is flooded on the trunk links.

STEPS:

1) "**Show vtp status"** to verify the running VTP version in SW1, SW2, and SW3.

```
SW1#show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 64
Number of existing VLANs        : 8
VTP Operating Mode              : Client
```

```
VTP Domain Name                 : zoom
VTP Pruning Mode                : Enabled
VTP V2 Mode                     : Enabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xE0 0x04 0x0D 0x7F 0x89 0xA0 0xC7 0xE8
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
```

NOTE: VTP version 2 is currently running in SW1, SW2 and SW3.

2) Configure VTP password "zoom" in SW1, SW2 and SW3.

SW1(config)#vtp password zoom
SW2(config)#vtp password zoom
SW3(config)#vtp password zoom

3) Configure VTP in such a way that no unnecessary VLAN traffic flooded on the trunk links.

SW1 (config)# vtp pruning

VERIFICATION:

In SW1, SW2 and SW3, use commands "show vtp password and show vtp status' and verify.
SW1#show vtp password

```
VTP Password: zoom
```

SW1#show vtp status

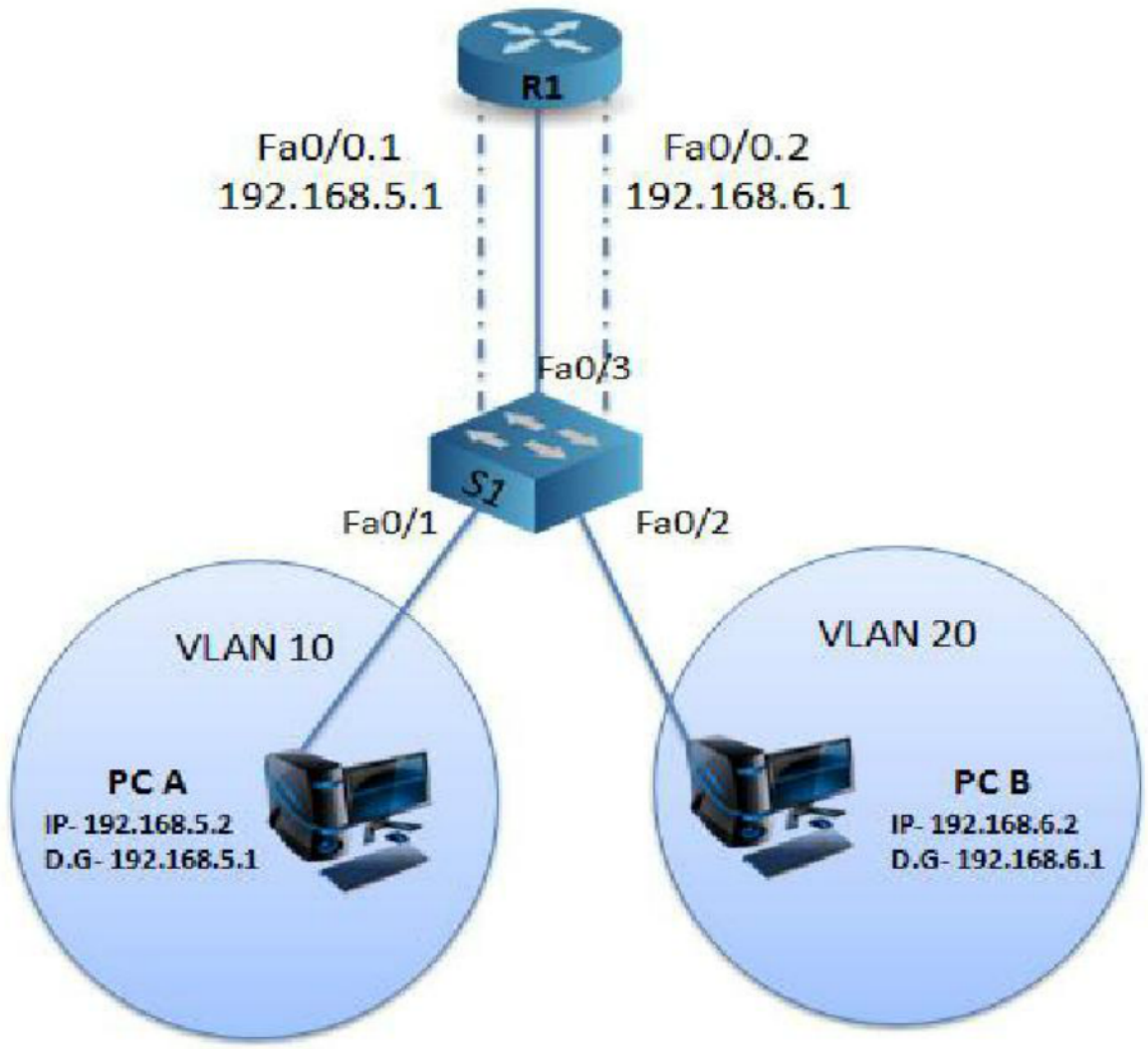
```
VTP Version                     : running VTP2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 8
VTP Operating Mode              : Server
VTP Domain Name                 : zoom
VTP Pruning Mode                : Enabled
VTP V2 Mode                     : Enabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x58 0x39 0xD9 0x7C 0xA4 0x9A 0x24 0x13
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
Local updater ID is 192.168.0.11 on interface Vl1 (lowest numbered VLAN interface found)
```

LAB 4: INTER VLAN ROUTING- Router on a stick

OBJECTIVE:

To configure inter VLAN routing , by setting up a router with sub interfaces for each VLAN

TOPOLOGY:



TASK:

1) Create VLANs and assign VLANs to the Interfaces
2) Configure the switch port connected to the router as a trunk port
3) Create Sub interfaces on the router – one sub interface for each VLAN
4) Verify that inter VLAN communication is possible.

STEPS:

1) Create VLANs and assign VLANs to the Interfaces

```
Switch(config)# VLAN 10
Switch(config-VLAN)# name IT
Switch(config-VLAN)#exit
Switch(config)# VLAN 20
Switch(config-VLAN)# name Sales
Switch(config-VLAN)#exit
```

Switch(config)# interface fastethernet 0/1
Switch(config-if)#switchport mode access
Switch(config)#switchport access VLAN 10
Switch(config)# interface fastethernet 0/2
Switch(config-if)#switchport mode access
Switch(config)#switchport access VLAN20

2) Configure the switch port connected to router as a trunk port

Switch(config)# interface fastethernet 0/3
Switch(config-if)# switchport mode trunk

3) Create Sub interfaces on the router – one subinterface for each VLAN

Router(config)# interface fastethernet 0/0.1
Router(config-if)# encapsulation dot1q 10
Router(config-if)# ip address 192.168.5.1 255.255.255.0
Router(config-if)#exit
Router(config)# interface fastethernet 0/0.2
Router(config-if)# encapsulation dot1q 20
Router(config-if)# ip address 192.168.6.1 255.255.255.0
Router(config-if)#exit

VERIFICATION:

Without configuring Inter vlan routing

PCA>ping 192.168.6.2
Pinging 192.168.6.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.6.2:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
PCB>ping 192.168.5.2

Pinging 192.168.6.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.5.2:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
After Configuring Inter Vlan routing
PCA>ping 192.168.6.2

Pinging 192.168.6.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.6.2: bytes=32 time=0ms TTL=127
Reply from 192.168.6.2: bytes=32 time=10ms TTL=127
Reply from 192.168.6.2: bytes=32 time=11ms TTL=127

Ping statistics for 192.168.6.2:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 11ms, Average = 7ms
PCB>ping 192.168.5.2

Pinging 192.168.5.2 with 32 bytes of data:

Reply from 192.168.5.2: bytes=32 time=11ms TTL=127
Reply from 192.168.5.2: bytes=32 time=10ms TTL=127
Reply from 192.168.5.2: bytes=32 time=0ms TTL=127
Reply from 192.168.5.2: bytes=32 time=0ms TTL=127

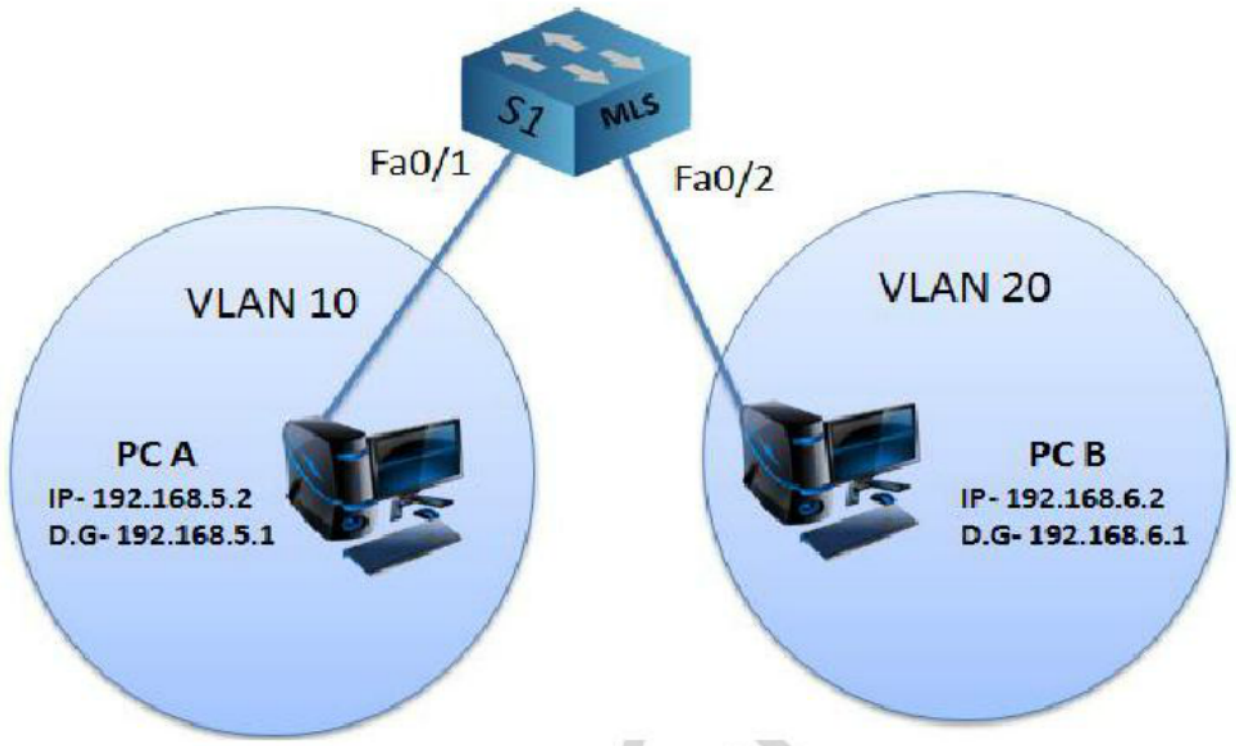
Ping statistics for 192.168.5.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 11ms, Average = 5ms

LAB 5: INTER VLAN ROUTING USING MLS (multi layer switch)

OBJECTIVE:

To configure Inter VLAN routing by using a multi layer switching (MLS)

TOPOLOGY:



TASK:

1) Create VLANs and assign VLANs to the Interfaces
2) Create SVI (switched virtual interface) on the MLS.
3) Verify that inter VLAN communication is happening

STEPS:

1) Create VLANs and assign VLANs to the Interfaces as done in previous lab. Enable Routing in MLS

   Switch(config)# ip routing

2) Create SVI (switched virtual interface)in MLS

   Switch(config)# interface VLAN 10
   Switch(config-VLAN)# ip address 192.168.5.1 255.255.255.0
   Switch(config-VLAN)# no shutdown
   Switch(config-VLAN)# exit
   Switch(config)# interface VLAN 20
   Switch(config-VLAN)# ip address 192.168.6.1 255.255.255.0
   Switch(config-VLAN)# no shutdown
   Switch(config-VLAN)# exit

VERIFICATION:

Before Configuring Inter Vlan routing with MLS

PCA >ping 192.168.6.2

Pinging 192.168.6.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.6.2:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PCB>ping 192.168.5.2

Pinging 192.168.5.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.5.2:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

After Configuring Inter Vlan routing with MLS
PCA >ping 192.168.6.2

Pinging 192.168.6.2 with 32 bytes of data:

Reply from 192.168.6.2: bytes=32 time=13ms TTL=127
Reply from 192.168.6.2: bytes=32 time=0ms TTL=127
Reply from 192.168.6.2: bytes=32 time=0ms TTL=127
Reply from 192.168.6.2: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.6.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 13ms, Average = 3ms

PCB>ping 192.168.5.2

Pinging 192.168.5.2 with 32 bytes of data:

Reply from 192.168.5.2: bytes=32 time=1ms TTL=127
Reply from 192.168.5.2: bytes=32 time=0ms TTL=127
Reply from 192.168.5.2: bytes=32 time=0ms TTL=127
Reply from 192.168.5.2: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.5.2:

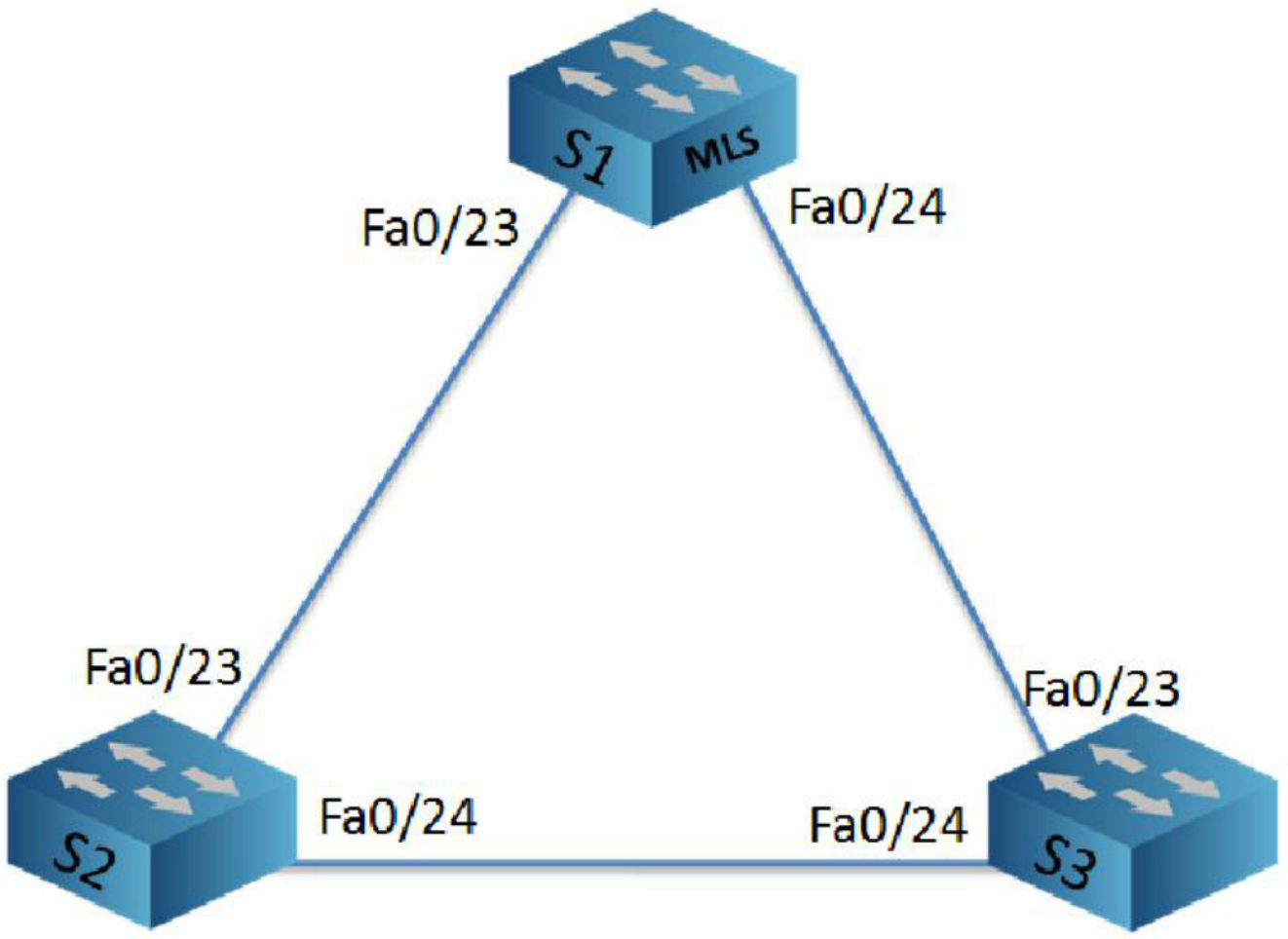
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms

LAB 6: BASIC SPANNING TREE

OBJECTIVE:

To verify STP behavior in a switched network.

TOPOLOGY:



TASK:

1) Find Out the MAC address of the switch
2) Observe STP behavior by doing the following :
3) Find Out Root Switch / Non Root Switch
4) Find Out Root Port, Designated Port and Non Designated Port

STEPS:

1) Find out the MAC address of the switch by using this command in all switches.

Switch# show version

Cisco IOS Software, C3560 Software (C3560-ADVIPSERVICESK9-M), Version 12.2(46)SE
, RELEASE SOFTWARE (fc2)
Copyright (c) 1986-2008 by Cisco Systems, Inc.

SWITCH uptime is 4 hours, 40 minutes
System returned to ROM by power-on
System image file is "flash:/c3560-advipservicesk9-mz.122-46.SE.bin"
The password-recovery mechanism is enabled.

<output omitted>
512K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address : 00:1A:E3:EE:F4:80
Motherboard assembly number : 73-9897-06
Power supply part number : 341-0097-02
Motherboard serial number : CAT110850X4
Power supply serial number : AZS110410X2
Model revision number : D0
Motherboard revision number : A0
Model number : WS-C3560-24TS-S
System serial number : CAT1108ZJ2K
Top Assembly Part Number : 800-26160-02
Top Assembly Revision Number : C0
Version ID : V02
CLEI Code Number : COMMG00ARB
Hardware Board Revision Number : 0x01
<output omitted>

2) Find out the Interfaces that are connected to other switches and make those ports as trunks in all switches.

SW(config)#interface range fastethernet 0/23 – 24
SW(config)#switchport mode trunk

VERIFICATION:

Verify the spanning tree on all the switches

Find out which switch is the root switch

SW1#sh spanning-tree

VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority : 32769
Address : 000c.8577.1340
Cost : 19
Port : 26 (FastEthernet0/24)
Hello Time : 2 sec
Max Age : 20 sec
Forward Delay : 15 sec
Bridge ID Priority : 32769 (priority 32768 sys-id-ext 1)
Address : 001a.e3ee.f480
Hello Time : 2 sec
Max Age : 20 sec
Forward Delay : 15 sec
Aging Time : 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg	FWD	19	128.3	P2p
Fa0/2	Desg	FWD	19	128.4	P2p

Fa0/3	Desg	FWD 19	128.5	P2p
Fa0/8	Desg	FWD 100	128.10	Shr
Fa0/9	Desg	FWD 19	128.11	P2p
Fa0/11	Desg	FWD 19	128.13	P2p
Fa0/13	Desg	FWD 19	128.15	P2p
Fa0/23	Altn	BLK 19	128.25	P2p
Fa0/24	Root	FWD 19	128.26	P2p

SW2#show spanning-tree

VLAN0001

Spanning tree enabled protocol ieee
Root ID Priority : 32769
Address : 000c.8577.1340
Cost : 19
Port : 22 (FastEthernet0/22)
Hello Time : 2 sec
Max Age : 20 sec
Forward Delay : 15 sec
Bridge ID Priority : 32769 (priority 32768 sys-id-ext 1)
Address : 000d.bce0.ec00
Aging Time : 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/23	Desg	FWD	19	128.21	P2p
Fa0/24	Root	FWD	19	128.22	P2p

SW3#show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority : 32769
Address : 000c.8577.1340
This bridge is the root
Hello Time : 2 sec
Max Age : 20 sec
Forward Delay : 15 sec
Bridge ID Priority : 32769 (priority 32768 sys-id-ext 1)
Address : 000c.8577.1340
Aging Time : 300

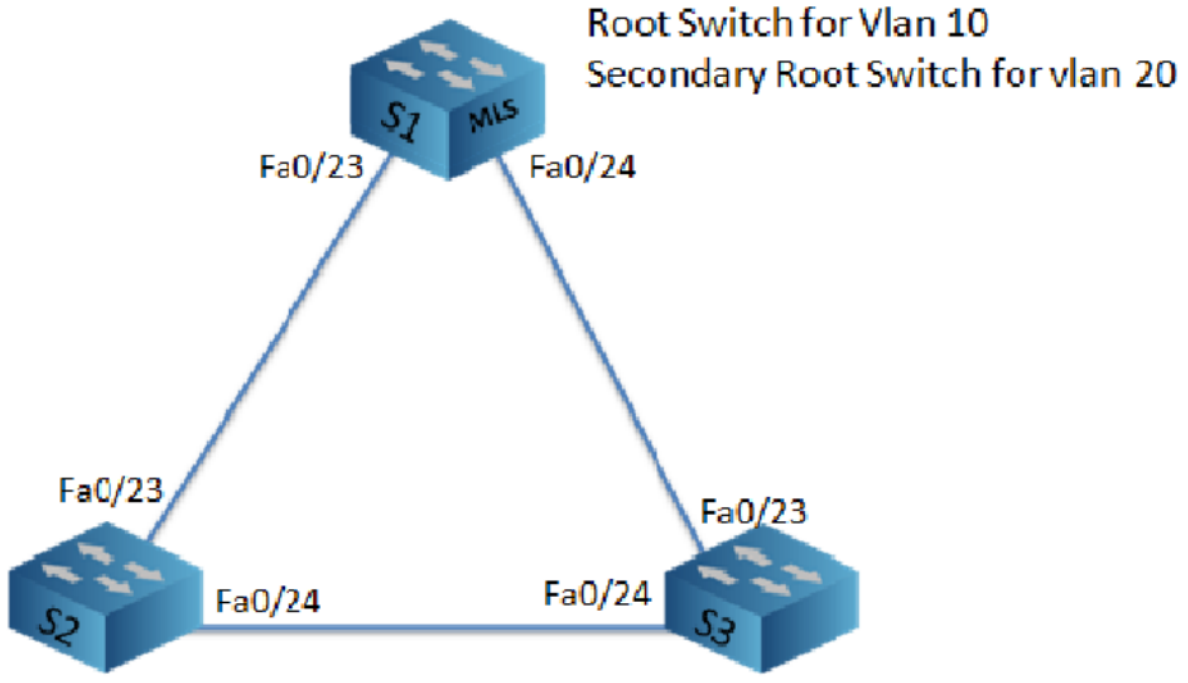
Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/23	Desg	FWD	19	128.21	P2p
Fa0/24	Desg	FWD	19	128.24	P2p

LAB 7: PVST (Per VLAN Spanning Tree)

OBJECTIVE:

To configure and observe the behavior of PVST in a switched network

TOPOLOGY:



Root Switch for Vlan 20
Secondary Root Switch for Vlan 30

Root Switch for Vlan 30
Secondary Root Switch for Vlan 10

TASK:

1) Find Out the MAC address of the switch
2) Make SW1 as Root Switch for VLAN 10 and backup Root Switch for VLAN 30
3) Make SW2 as Root switch for VLAN 20 and backup Root Switch for VLAN 10
4) Make SW3 as Root Switch for VLAN 30 and backup Root switch for VLAN 20
5) Find Out Root Port, Designated Port and Non Designated Port

STEPS:

1) Create VLANs in all the switches

SW1(config)# VLAN 10
SW1(config-VLAN)#name CCNA
SW1(config)# VLAN 20
SW1(config-VLAN)#name CCNP
SW1(config)# VLAN 30
SW1(config-VLAN)#name CCIE
SW2(config)# VLAN 10

SW2(config-VLAN)#name CCNA
SW2(config)# VLAN 20
SW2(config-VLAN)#name CCNP
SW2(config)# VLAN 30
SW2(config-VLAN)#name CCIE
SW3(config)# VLAN 10
SW3(config-VLAN)#name CCNA
SW3(config)# VLAN 20
SW3(config-VLAN)#name CCNP
SW3(config)# VLAN 30
SW3(config-VLAN)#name CCIE

2) Enable PVST in all switches.

SW1,SW2,SW3(conf)# spanning-tree mode pvst

3) Make SW1 as Root Switch for VLAN 10 and backup Root Switch for VLAN 30

SW1(config)#spanning-tree VLAN 10 root primary
SW1(config)#spanning-tree VLAN 30 root secondary

4) Make the SW2 as root switch for VLAN 20 secondary root switch for VLAN 10.

SW2(config)#spanning-tree VLAN 20 root primary
SW2(config)#spanning-tree VLAN 10 root secondary

5) Make SW3 as Root Switch for VLAN 30 and backup Root switch for VLAN 20

SW3(config)#spanning-tree VLAN 30 root primary
SW3(config)#spanning-tree VLAN 20 root secondary

VERIFICATION:

SW1#show spanning-tree

In SW2 and SW3 also verify with "**show spanning-tree"** command.

```
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000c.8577.1340
             Cost        38
             Port        23 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     001a.e3ee.f480
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7            Desg FWD 19        128.9    P2p
Fa0/11           Desg FWD 19        128.13   P2p
Fa0/12           Desg FWD 19        128.14   P2p
```

```
Fa0/23           Desg FWD 19      128.15   P2p
Fa0/24           Root FWD 19      128.23   P2p

VLAN0010
  Spanning tree enabled protocol ieee
  Root ID    Priority    24586
             Address     001a.e3ee.f480
This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24586  (priority 24576 sys-id-ext 10)
             Address     001a.e3ee.f480
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/23           Desg FWD 19      128.23   P2p
Fa0/24           Desg FWD 19      128.26   P2p

VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    24596
             Address     000d.bce0.ec00
             Cost        19
             Port        23 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    28692  (priority 28672 sys-id-ext 20)
             Address     001a.e3ee.f480
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/23           Root FWD 19      128.23   P2p
Fa0/24           Desg FWD 19      128.26   P2p

VLAN0030
  Spanning tree enabled protocol ieee
  Root ID    Priority    24606
             Address     000c.8577.1340
             Cost        38
             Port        23 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32798  (priority 32768 sys-id-ext 30)
             Address     001a.e3ee.f480
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
```

```
Fa0/23           Altn BLK    19    128.23       P2p
Fa0/24           Root FWD 19    128.26       P2p
```

SW2#show spanning-tree vlan 20

```
VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    24596
             Address     000d.bce0.ec00
This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24596  (priority 24576 sys-id-ext 20)
             Address     000d.bce0.ec00
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/23           Desg FWD 19        128.23   P2p
Fa0/24           Desg FWD 19        128.24   P2p
```

SW3#show spanning-tree vlan 30

```
VLAN0030
  Spanning tree enabled protocol ieee
  Root ID    Priority    24606
             Address     000c.8577.1340
This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    24606  (priority 24576 sys-id-ext 30)
             Address     000c.8577.1340
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/22           Desg FWD 19        128.22   P2p
Fa0/24           Desg FWD 19        128.24   P2p
```

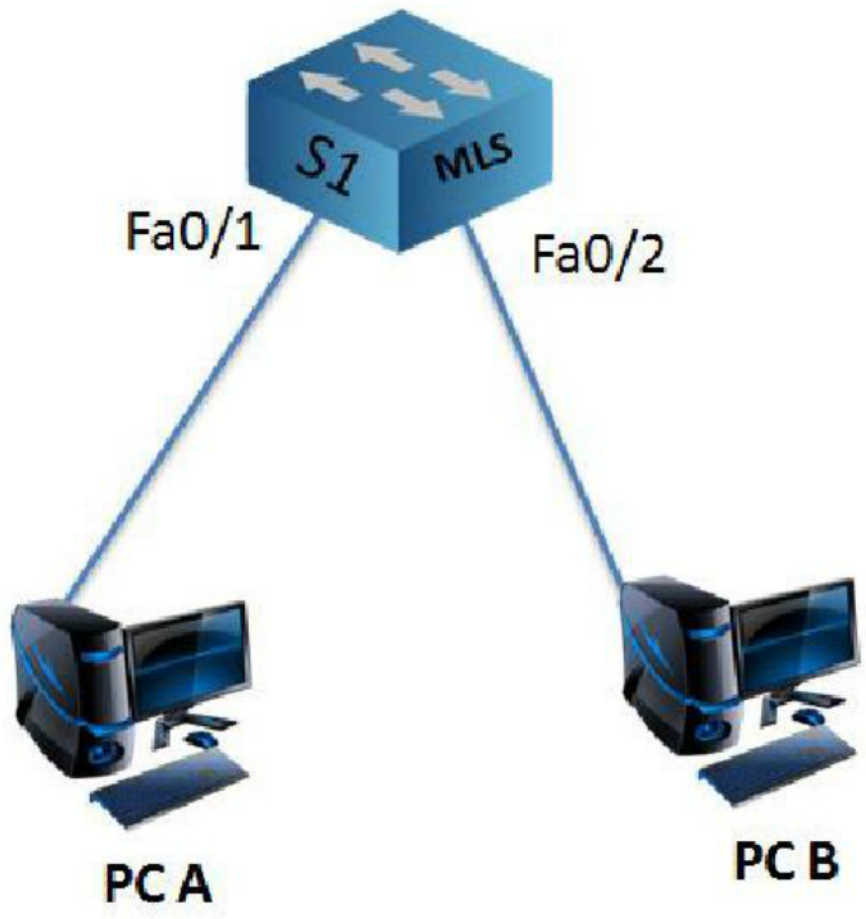
LAB 8: SPANNING TREE PORTFAST

OBJECTIVE:

To configure Port Fast , to enable ports to transition immediately to the forwarding state in STP , without going through the listening and learning states

NOTE: It is recommended to configure Port Fast only on ports which are directly connected to a single workstation.

TOPOLOGY:



TASK:

1) Configure the ports that are connected to PC on switch as Port Fast ports.
2) Verify that these ports immediately come to the forwarding state.

STEPS:

1) Find out the ports which are connected to PC's on the switch by using the command

   SW# show mac-address-table dynamic

   Mac Address Table

   VLAN Mac Address Type Ports
   ---- ---------- -------- -----
   1 000c.8577.1358 DYNAMIC Fa0/24

1	000c.857d.2d09	DYNAMIC	Fa0/13
1	000f.2411.70c0	DYNAMIC	Fa0/2
1	000f.90bb.96c0	DYNAMIC	Fa0/1
1	0011.928f.68e0	DYNAMIC	Fa0/3
1	00d0.586c.23e0	DYNAMIC	Fa0/8
1	0cd2.b516.b9dc	DYNAMIC	Fa0/13
1	3819.2ffa.dafe	DYNAMIC	Fa0/13
1	b0df.3a1f.a535	DYNAMIC	Fa0/13
1	bcae.c5d8.9be7	DYNAMIC	Fa0/13

Total Mac Addresses for this criterion: 10

2) Make those ports as Port Fast ports.

Switch (config)# interface range fastethernet 0/1-2

Switch(Config-if)# spanning-tree portfast

VERIFICATION:

SW1#sh spanning-tree int fa0/2 detail

Port 10 (FastEthernet0/8) of VLAN0001 is designated forwarding

Port path cost 100, Port priority 128, Port Identifier 128.10.

Designated root has priority 32769, address 000c.8577.1340

Designated bridge has priority 32769, address 001a.e3ee.f480

Designated port id is 128.10, designated path cost 19

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

The port is in the portfast mode

Link type is shared by default

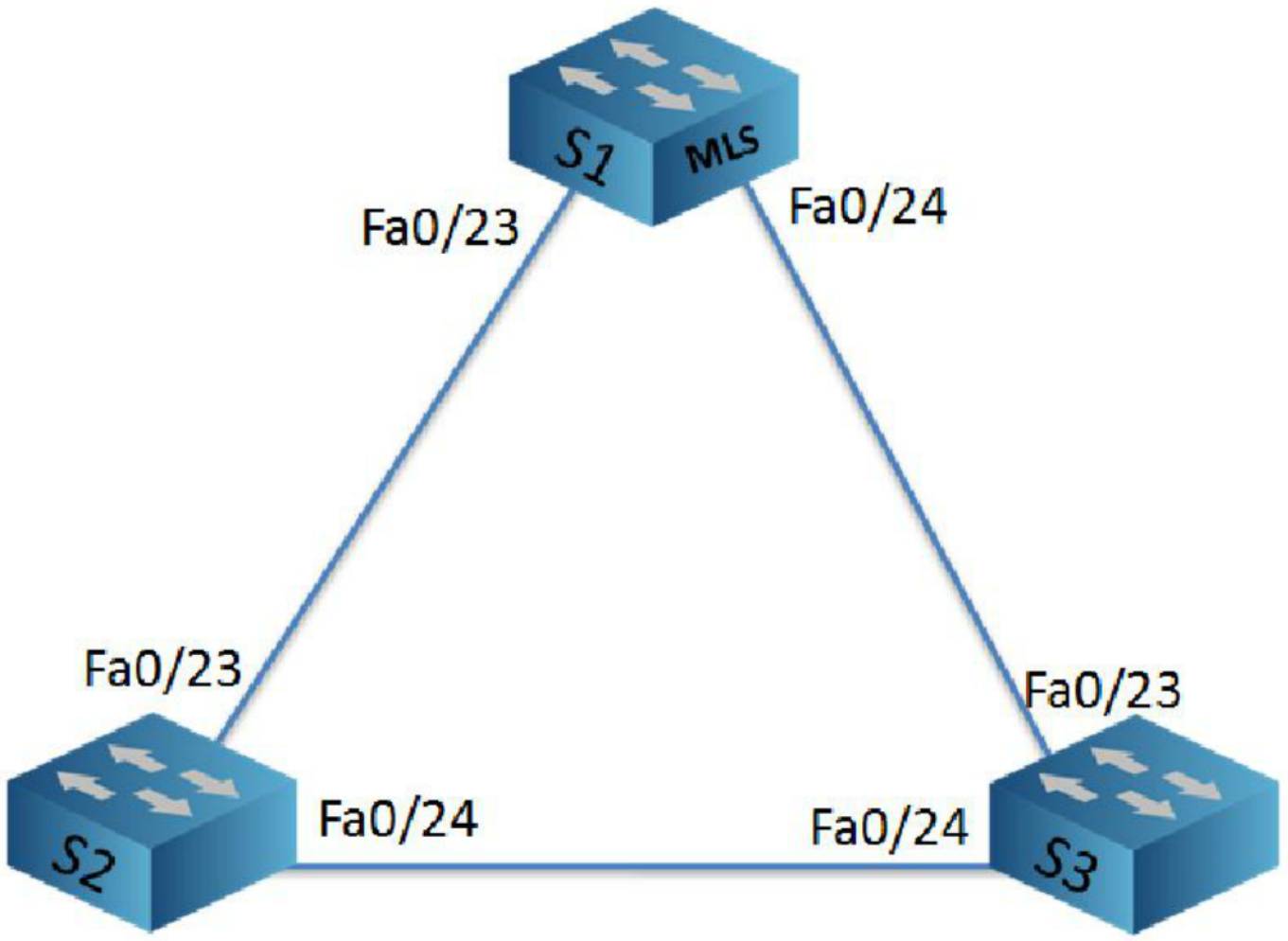
BPDU: sent 4012, received 0

LAB 9: STP UPLINKFAST

OBJECTIVE:

To configure Uplink Fast to provide fast convergence in case of a link failure

TOPOLOGY:



TASK:

1) Configure Uplink fast on the switch that is having non designated port
2) Verify that the port immediately goes to forwarding state in the event of a link failure.

STEPS:

1) Find out the switch which has blocked port and configure the switch as Uplink fast.

   Switch1# show spanning-tree summary

   VLAN0001
   Spanning tree enabled protocol ieee
   Root ID Priority 32769
   Address 000c.8577.1340
   Cost 19
   Port 26 (FastEthernet0/24)
   Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
   Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
   Address 001a.e3ee.f480
   Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

```
          Aging Time 300
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    P2p Edge
Fa0/2            Desg FWD 19        128.4    P2p Edge
Fa0/3            Desg FWD 19        128.5    P2p
Fa0/8            Desg FWD 100       128.10 Shr
Fa0/13           Desg FWD 19        128.15   P2p
Fa0/23           Altn  BLK  19      128.25   P2p
Fa0/24           Root FWD 19        128.26   P2p
```

2) Configure Uplink Fast

Switch(config)# spanning-tree uplinkfast

VERIFICATION:

Before Configuring Uplinkfast

Shutdown the root port of the switch and try to ping switch IP Address

```
Pinging 192.168.0.11 with 32 bytes of data:
Reply from 192.168.0.11: bytes=32 time=4ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=4ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Reply from 192.168.0.11: bytes=32 time=1027ms TTL=255
Reply from 192.168.0.11: bytes=32 time=13ms TTL=255
Reply from 192.168.0.11: bytes=32 time=5ms TTL=255
Reply from 192.168.0.11: bytes=32 time=2ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
```

After Configuring Uplinkfast

Shutdown the root port of the switch and try to ping switch IP Address

```
Pinging 192.168.0.11 with 32 bytes of data:
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
```

```
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Request timed out.
Reply from 192.168.0.11: bytes=32 time=2ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
```

SW1#sh spanning-tree summary

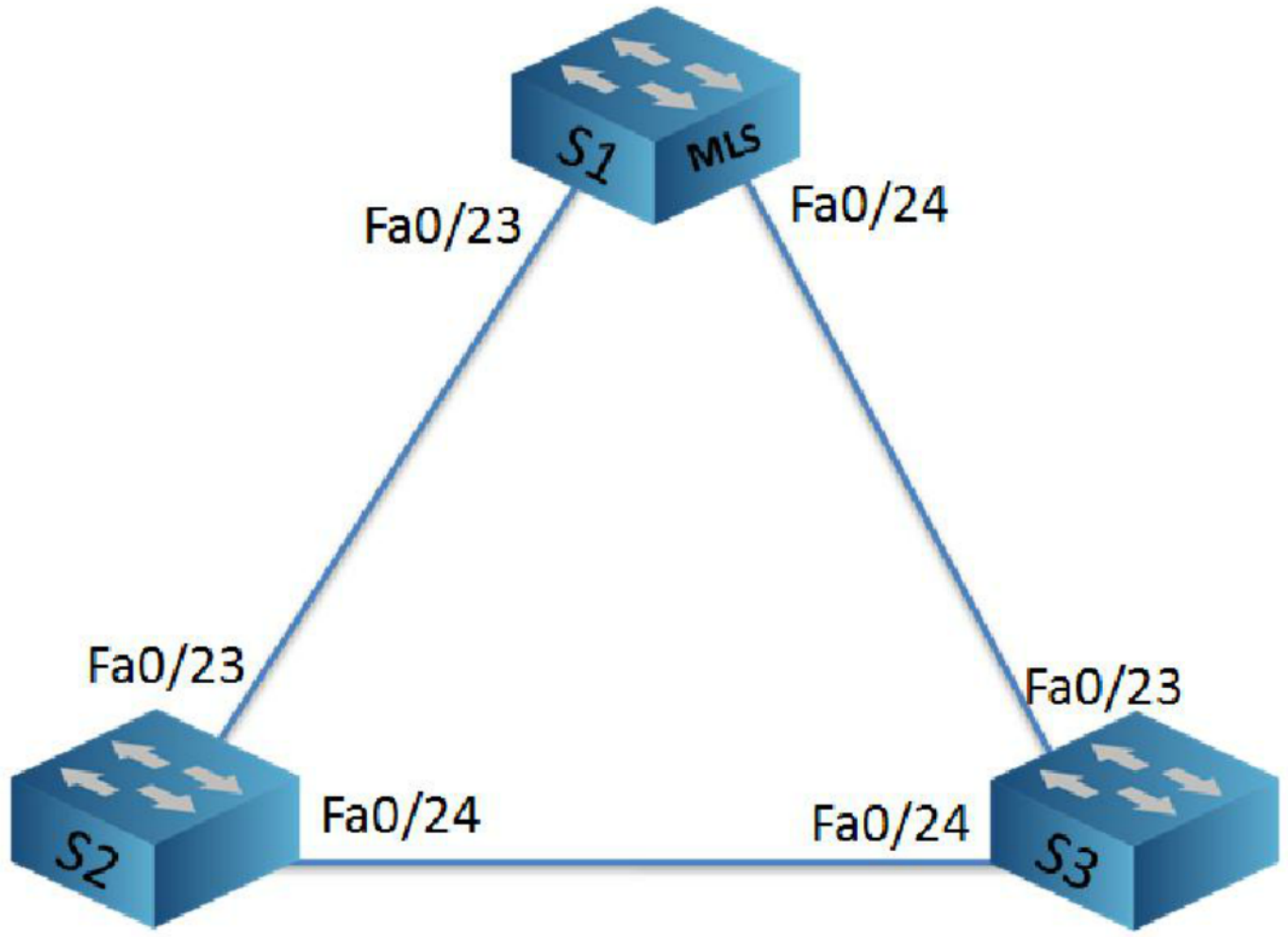
```
Switch is in pvst mode
Root bridge for: none
Ether Channel misconfig guard is     : enabled
Extended system ID is                : enabled
Portfast Default is                  : disabled
PortFast BPDU Guard Default is       : disabled
Portfast BPDU Filter Default is      : disabled
Loopguard Default is                 : disabled
UplinkFast                           :  enabled
BackboneFast is                      : disabled
Pathcost method used is              : short
Uplink Fast statistics:
Number of transitions via uplinkFast (all VLANs)              : 0
Number of proxy multicast addresses transmitted (all VLANs)   : 0
```

LAB 10: STP BACKBONEFAST

OBJECTIVE:

To configure Backbone Fast for fast convergence of STP in the event of a link failure in a switched network

TOPOLOGY:



TASK:

1) Configure backbone fast on all the switches
2) Observe STP convergence when a link fails (disconnect one of the cables between the switches)

STEPS:

1) Configure Backbone fast on all the switches

   Switch(config)# spanning-tree backbonefast

VERIFICATION:

SW1# show spanning-tree summary

Switch is in pvst mode

Root bridge for: VLAN0001, VLAN0010, VLAN0020, VLAN0030
Extended system ID is enabled

```
Portfast Default                        is disabled
PortFast BPDU Guard Default             is disabled
Portfast BPDU Filter Default            is disabled
Loopguard Default                       is disabled
EtherChannel misconfig guard            is enabled
UplinkFast                              is disabled
BackboneFast                            is enabled
Configured Pathcost method used is short
BackboneFast statistics
Number of transition via backboneFast (all VLANs)       : 0
Number of inferior BPDUs received (all VLANs)           : 0
Number of RLQ request PDUs received (all VLANs)         : 0
Number of RLQ response PDUs received (all VLANs)        : 0
Number of RLQ request PDUs sent (all VLANs)             : 0
Number of RLQ response PDUs sent (all VLANs)            : 0
```

SW2# show spanning-tree summary

```
Switch is in pvst mode
Root bridge for: none
EtherChannel misconfig guard            is enabled
Extended system ID                      is enabled
Portfast Default                        is disabled
PortFast BPDU Guard Default             is disabled
Portfast BPDU Filter Default            is disabled
Loopguard Default                       is disabled
UplinkFast                              is enabled
BackboneFast                            is enabled
Pathcost method used                    is short
Station update rate set to 150 packets/sec.
UplinkFast statistics
Number of transitions via uplinkFast (all VLANs)            : 0
Number of proxy multicast addresses transmitted (all VLANs) : 0
BackboneFast statistics
Number of transition via backboneFast (all VLANs)           : 0
Number of inferior BPDUs received (all VLANs)               : 0
Number of RLQ request PDUs received (all VLANs)             : 0
Number of RLQ response PDUs received (all VLANs)            : 0
Number of RLQ request PDUs sent (all VLANs)                 : 0
Number of RLQ response PDUs sent (all VLANs)                : 0
```

SW3#sh spanning-tree summary

```
Switch is in pvst mode
Root bridge for: none
EtherChannel misconfig guard            is enabled
Extended system ID                      is enabled
Portfast Default                        is disabled
PortFast BPDU Guard Default             is disabled
Portfast BPDU Filter Default            is disabled
Loopguard Default                       is disabled
```

```
UplinkFast                                      is disabled
BackboneFast                                    is enabled
Pathcost method used                            is short
BackboneFast statistics
Number of transition via backboneFast (all VLANs)       : 0
Number of inferior BPDUs received (all VLANs)           : 0
Number of RLQ request PDUs received (all VLANs)         : 0
Number of RLQ response PDUs received (all VLANs)        : 0
Number of RLQ request PDUs sent (all VLANs)             : 0
Number of RLQ response PDUs sent (all VLANs)            : 0
```

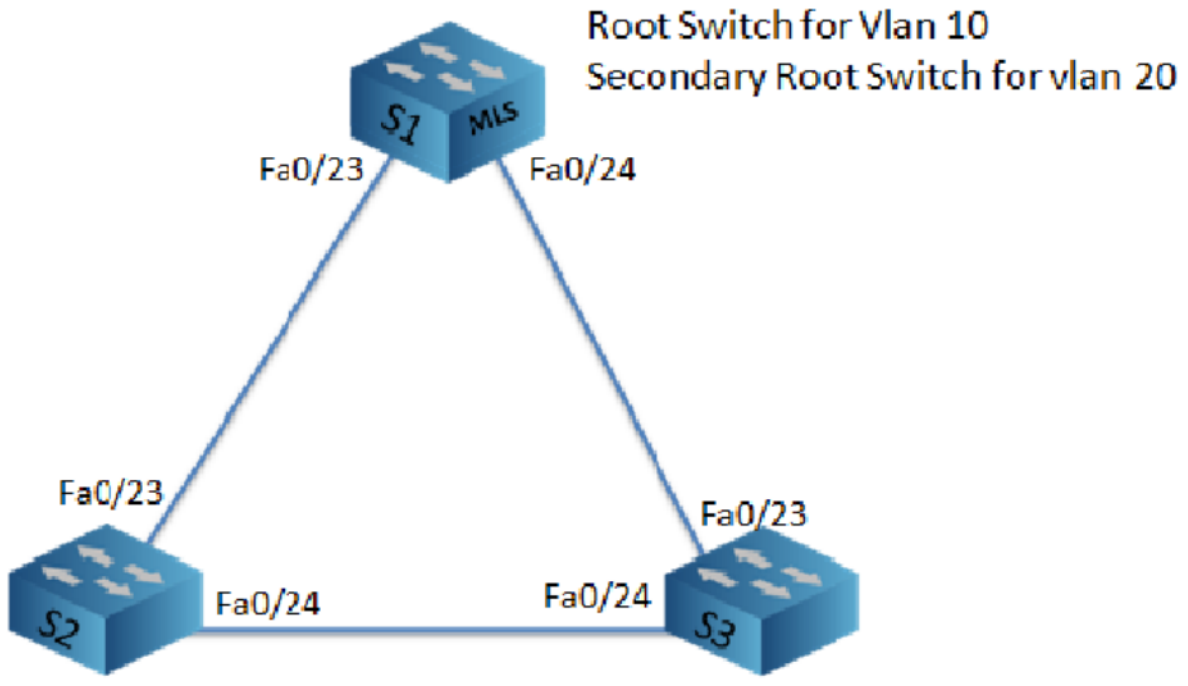
Note: Verify the output by shutting down indirectly connected link i.e. any link that is not directly connected to the switch with the blocked port, and note that blocked state immediately comes up. This can be tested by keeping a ping on between two machines on two different PCs.

LAB 11: RAPID PVST

OBJECTIVE:

To configure Rapid PVST and observe its behavior

TOPOLOGY:



Root Switch for Vlan 20
Secondary Root Switch for Vlan 30

Root Switch for Vlan 30
Secondary Root Switch for Vlan 10

TASK:

1) Find Out the MAC address of the switch
2) Enable Rapid PVST in all switches
3) Make SW1 as Root Switch for VLAN 10 and backup Root Switch for VLAN 30
4) Make SW2 as Root switch for VLAN 20 and backup Root Switch for VLAN 10
5) Make SW3 as Root Switch for VLAN 30 and backup Root switch for VLAN 20
6) Find Out Root Port, Designated Port and Non Designated Port

STEPS:

1) Create VLANs in all the switches

SW1(config)# VLAN 10
SW1(config-VLAN)#name CCNA
SW1(config)# VLAN 20
SW1(config-VLAN)#name CCNP
SW1(config)# VLAN 30

SW1(config-VLAN)#name CCIE
SW2(config)# VLAN 10
SW2(config-VLAN)#name CCNA
SW2(config)# VLAN 20
SW2(config-VLAN)#name CCNP
SW2(config)# VLAN 30
SW2(config-VLAN)#name CCIE
SW3(config)# VLAN 10
SW3(config-VLAN)#name CCNA
SW3(config)# VLAN 20
SW3(config-VLAN)#name CCNP
SW3(config)# VLAN 30
SW3(config-VLAN)#name CCIE

2) Enable Rapid PVST in all switches.

SW1,SW2,SW3(conf)# spanning-tree mode rapid-pvst

3) Make SW1 as Root Switch for VLAN 10 and backup Root Switch for VLAN 30

SW1(config)#spanning-tree VLAN 10 root primary
SW1(config)#spanning-tree VLAN 30 root secondary

4) Make the SW2 as root switch for VLAN 20 secondary root switch for VLAN 10.

SW2(config)#spanning-tree VLAN 20 root primary
SW2(config)#spanning-tree VLAN 10 root secondary

5) Make SW3 as Root Switch for VLAN 30 and backup Root switch for VLAN 20

SW3(config)#spanning-tree VLAN 30 root primary
SW3(config)#spanning-tree VLAN 20 root secondary

VERIFICATION:

SW1#sh spanning-tree

VLAN0001

Spanning tree enabled protocol rstp
Root ID Priority 24577
Address 001a.e3ee.f480
This bridge is the root
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 24577 (priority 24576 sys-id-ext 1)
Address 001a.e3ee.f480
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg	FWD	19	128.3	P2p

Fa0/2	Desg FWD	19	128.4	P2p
Fa0/3	Desg FWD	19	128.5	P2p
Fa0/8	Desg FWD	100	128.10	Shr Edge
Fa0/9	Desg FWD	19	128.11	P2p Edge
Fa0/11	Desg FWD	19	128.13	P2p Edge
Fa0/13	Desg FWD	19	128.15	P2p Peer(STP)
Fa0/23	Desg FWD	19	128.25	P2p
Fa0/24	Desg FWD	19	128.26	P2p

VLAN0010

Spanning tree enabled protocol rstp
Root ID Priority 24586
Address 001a.e3ee.f480
This bridge is the root
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 24586 (priority 24576 sys-id-ext 10)
Address 001a.e3ee.f480
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300

Interface	Role Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg FWD	19	128.3	P2p
Fa0/13	Desg FWD	19	128.15	P2p
Fa0/23	Desg FWD	19	128.25	P2p
Fa0/24	Back BLK	19	128.26	P2p

SW2#sh spanning-tree VLAN 20
VLAN0020

Spanning tree enabled protocol rstp
Root ID Priority 28692
Address 001a.e3ee.f480
This bridge is the root
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 28692 (priority 28672 sys-id-ext 20)
Address 001a.e3ee.f480
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300

Interface	Role Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg FWD	19	128.3	P2p
Fa0/13	Desg FWD	19	128.15	P2p
Fa0/23	Desg FWD	19	128.25	P2p
Fa0/24	Back BLK	19	128.26	P2p

SW1#sh spanning-tree VLAN 30
VLAN0030

Spanning tree enabled protocol rstp
Root ID Priority 28702

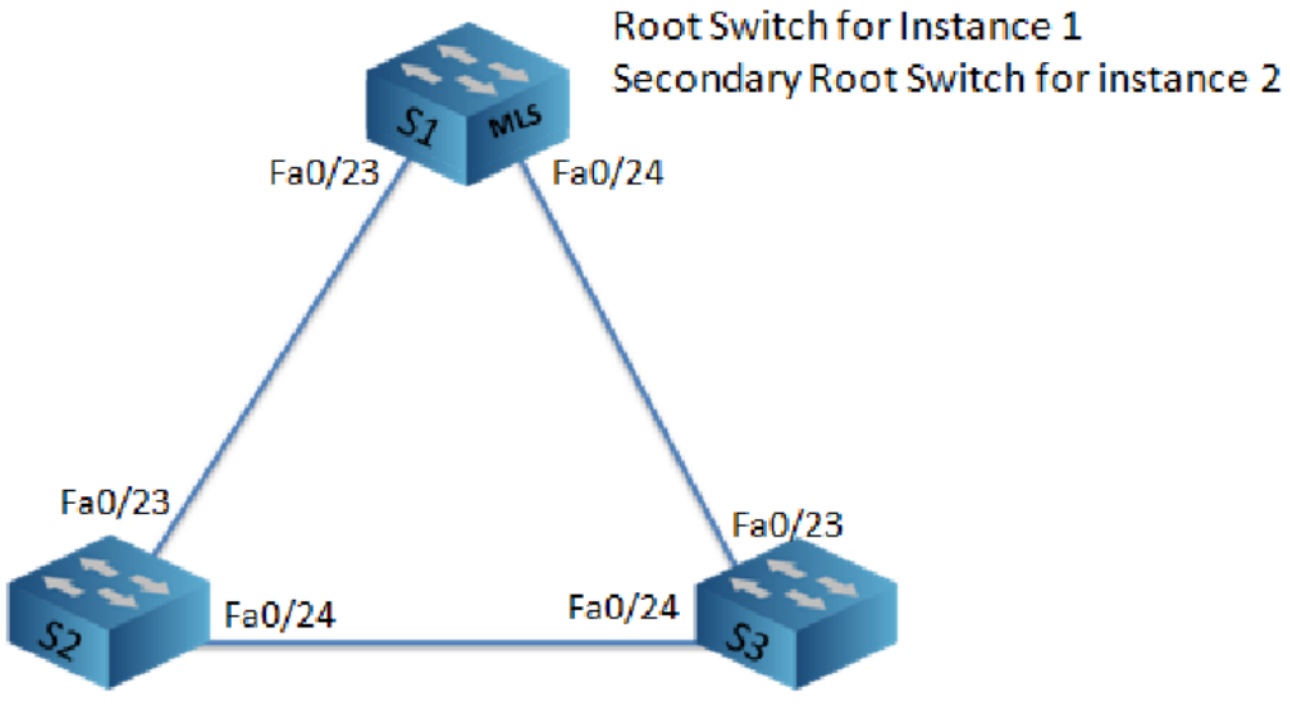
```
        Address     001a.e3ee.f480
This bridge is the root
        Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    28702  (priority 28672 sys-id-ext 30)
        Address     001a.e3ee.f480
        Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
        Aging Time 300
Interface        Role Sts                Cost    Prio.Nbr          Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD                19      128.3             P2p
Fa0/13           Desg FWD                19      128.15            P2p
Fa0/23           Desg FWD                19      128.25            P2p
Fa0/24           Back BLK                19      128.26            P2p
```

LAB 12: Multiple Spanning Tree MST

OBJECTIVE:

To configure MST and observe its behavior in a switched network

TOPOLOGY:



Root Switch for Instance 2
Secondary Root Switch for instance 3

Root Switch for Instance 3
Secondary Root Switch for instance 1

TASK:

1) Enable MST in all switches
2) Configure MST instances as following in all the switches

   MST instance 1 (VLAN 1-10)
   MST instance 2 (VLAN 11-20)
   MST instance 3 (VLAN 21-30)

3) Make SW1 as Root Switch for Instance 1 and backup Root Switch for Instance 2
4) Make SW2 as Root switch for Instance 2 and backup Root Switch for Instance 3
5) Make SW3 as Root Switch for Instance 3 and backup Root switch for Instance 1
6) Find Out Root Port, Designated Port and Non Designated Port

STEPS:

1) Enable MST in all switches

Switch(config)# spanning-tree mode mst

2) Configure MST instances as following in all the switches

MST instance 1 (VLAN 1-10)
MST instance 2 (VLAN 11-20)
MST instance 3 (VLAN 21-30)

SW1(config)#spanning-tree mst configuration
SW1(config-mst)#instance 1 VLAN 1-10
SW1(config-mst)#instance 2 VLAN 11-20
SW1(config-mst)#instance 3 VLAN 21-30
SW1(config-mst)#name zoom
SW1(config-mst)#revision 1
SW1(config-mst)#exit
SW2(config)# spanning-tree mst configuration
SW2(config-mst)#instance 1 VLAN 1-10
SW2(config-mst)#instance 2 VLAN 11-20
SW2(config-mst)#instance 3 VLAN 21-30
SW2(config-mst)#name zoom
SW2(config-mst)#revision 1
SW2(config-mst)#exit
SW3(config)#spanning-tree mst configuration
SW3(config-mst)#instance 1 VLAN 1-10
SW3(config-mst)#instance 2 VLAN 11-20
SW3(config-mst)#instance 3 VLAN 21-30
SW3(config-mst)#name zoom
SW3(config-mst)#revision 1
SW3(config-mst)#exit

3) Make SW1 as Root Switch for Instance 1 and backup Root Switch for Instance 2.

SW1(config)#spanning-tree mst 1 root primary
SW1(config)#spanning-tree mst 2 root secondary

4) Make SW2 as Root switch for Instance 2 and backup Root Switch for Instance 3

SW2(config)#spanning-tree mst 2 root primary
SW2(config)#spanning-tree mst 2 root secondary

5) Make SW3 as Root Switch for Instance 3 and backup Root switch for Instance 1

SW3(config)#spanning-tree mst 3 root primary
SW3(config)#spanning-tree mst 1 root secondary

VERIFICATION:

G1SW1#show spanning-tree
MST0
Spanning tree enabled protocol mstp
Root ID Priority 32768
Address 000d.bce0.ec00
Cost 0
Port 25 (FastEthernet0/23)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

```
 Bridge ID Priority    32768 (priority 32768 sys-id-ext 0)
         Address     001a.e3ee.f480
         Hello Time   2 sec Max Age 20 sec Forward Delay 15 sec

Interface         Role Sts Cost      Prio.Nbr       Type
------------------- ---- --- --------- -------- --------------------------
Fa0/13            Desg FWD 200000    128.15   P2p Bound(STP)
Fa0/23            Root FWD 200000    128.25   P2p Pre-STD-Rx
Fa0/24            Desg BKN*200000    128.26   P2p Bound(PVST) *PVST_Inc
```

MST1

```
Spanning tree enabled protocol mstp
Root ID    Priority    24577
         Address     001a.e3ee.f480
         This bridge is the root
         Hello Time   2 sec Max Age 20 sec  Forward Delay 15 sec
 Bridge ID Priority    24577 (priority 24576 sys-id-ext 1)
         Address     001a.e3ee.f480
         Hello Time   2 sec Max Age 20 sec Forward Delay 15 sec
Interface         Role Sts Cost      Prio.Nbr       Type
------------------- ---- --- --------- -------- --------------------------
Fa0/13            Desg FWD 200000    128.15   P2p Bound(STP)
Fa0/23            Desg FWD 200000    128.25   P2p Pre-STD-Rx
Fa0/24            Desg BKN*200000    128.26   P2p Bound(PVST) *PVST_Inc
```

MST2

```
Spanning tree enabled protocol mstp
Root ID    Priority    24578
         Address     000d.bce0.ec00
         Cost        200000
         Port        25 (FastEthernet0/23)
         Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
 Bridge ID  Priority    28674  (priority 28672 sys-id-ext 2)
         Address     001a.e3ee.f480
         Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
Interface         Role Sts Cost      Prio.Nbr       Type
------------------- ---- --- --------- -------- --------------------------
Fa0/13            Desg FWD 200000    128.15   P2p Bound(STP)
Fa0/23            Root FWD 200000    128.25   P2p Pre-STD-Rx
Fa0/24            Desg BKN*200000    128.26   P2p Bound(PVST) *PVST_Inc
```

MST3

```
Spanning tree enabled protocol mstp
Root ID    Priority    28675
         Address     000d.bce0.ec00
         Cost        200000
         Port        25 (FastEthernet0/23)
         Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
 Bridge ID  Priority    32771  (priority 32768 sys-id-ext 3)
```

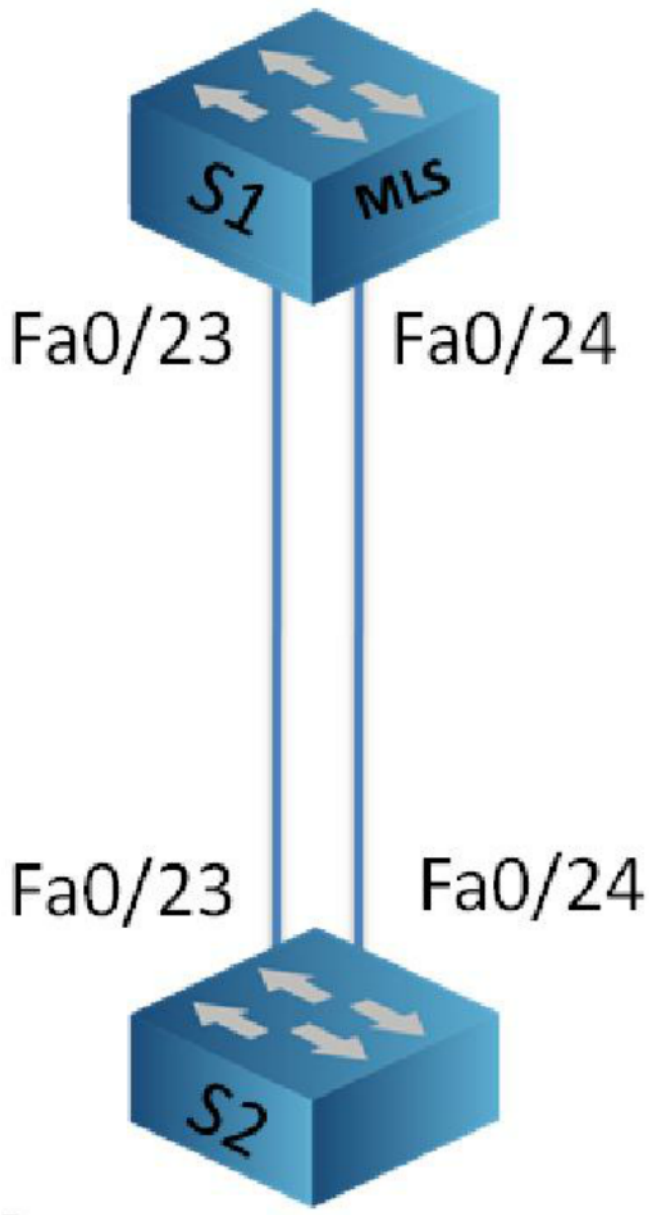
```
        Address     001a.e3ee.f480
        Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

Interface        Role Sts Cost      Prio.Nbr       Type
---------------- ---- --- --------- -------- --------------------------
Fa0/13           Desg FWD 200000    128.15   P2p Bound(STP)
Fa0/23           Root FWD 200000    128.25   P2p Pre-STD-Rx
Fa0/24           Desg BKN*200000    128.26   P2p Bound(PVST) *PVST_Inc
```

LAB 13: ETHERCHANNEL

OBJECTIVE:

To configure an Ether Channel to aggregate multiple ports into a single , logical , high speed port

TOPOLOGY:



TASK:

1) Configure Ether channel by aggregating two ports between SW1 and SW2
2) Verify the output

STEPS:

1) Configure Ether channel in Switch1 and Switch 2.

```
Switch1(config)# interface range fastethernet 0/23-24
Switch1(config-if)# switchport mode trunk
Switch1(config-if)# channel-group 1 mode on

Switch2(config)# interface range fastethernet 0/23-24
Switch2(config-if)# switchport mode trunk
Switch2(config-if)# channel-group 1 mode on
```

VERIFICATION:

Switch1#show etherchannel summary

```
Flags:  D - down        P - bundled in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port
Number of channel-groups in use: 1
Number of aggregators:          1
Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
1               Po1(SU)         -       Fa0/23(P)   Fa0/24(s)
```

Switch1#show interfaces port-channel 1

```
Port-channel1 is up, line protocol is up (connected)
Hardware is EtherChannel, address is 001a.e3ee.f499 (bia 001a.e3ee.f499)
MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, link type is auto, media type is unknown
  input flow-control is off, output flow-control is unsupported
  Members in this channel: Fa0/23
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:01, output 00:00:05, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     1083 packets input, 108072 bytes, 0 no buffer
     Received 1506 broadcasts (798 multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 798 multicast, 0 pause input
     0 input packets with dribble condition detected
     2877 packets output, 235149 bytes, 0 underruns
     0 output errors, 0 collisions, 7 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
```

Switch1 #show spanning-tree

```
VLAN0001
Spanning tree enabled protocol ieee
Root ID    Priority    32768
```

```
        Address    000c.8577.1340
        Cost       38
        Port       56 (Port-channel1)
        Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
        Address    001a.e3ee.f480
        Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
        Aging Time 300
Interface        Role Sts Cost      Prio.Nbr        Type
---------------- ---- --- --------- -------- --------------------------
Fa0/13           Desg FWD 19        128.15          P2p
Po1              Root FWD 19        128.56          P2p
```

Switch2#show etherchannel summary

```
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        u - unsuitable for bundling
        U - in use      f - failed to allocate aggregator
        d - default port
Number of channel-groups in use: 1
Number of aggregators:           1
Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
1      Po1(SU)         -        Fa0/22(D)   Fa0/23(Pd)
```

Switch2#show interfaces port-channel 1

```
Port-channel1 is up, line protocol is up (connected)
  Hardware is EtherChannel, address is 000d.bce0.ec17 (bia 000d.bce0.ec17)
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Full-duplex, 100Mb/s, media type is unknown media type
  input flow-control is off, output flow-control is off
  Members in this channel: Fa0/23
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output 00:00:01, output hang never
  Last clearing of "show interface" counters never
  Input queue: 1/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 1000 bits/sec, 2 packets/sec
  5 minute output rate 1000 bits/sec, 2 packets/sec
     2719 packets input, 208851 bytes, 0 no buffer
     Received 2332 broadcasts (0 multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 2251 multicast, 0 pause input
     0 input packets with dribble condition detected
     1126 packets output, 95106 bytes, 0 underruns
```

0 output errors, 0 collisions, 1 interface resets
0 babbles, 0 late collision, 0 deferred
0 lost carrier, 0 no carrier, 0 PAUSE output
0 output buffer failures, 0 output buffers swapped out

Switch2#show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 32768
Address 000c.8577.1340
Cost 19
Port 24 (FastEthernet0/24)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
Address 000d.bce0.ec00
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300

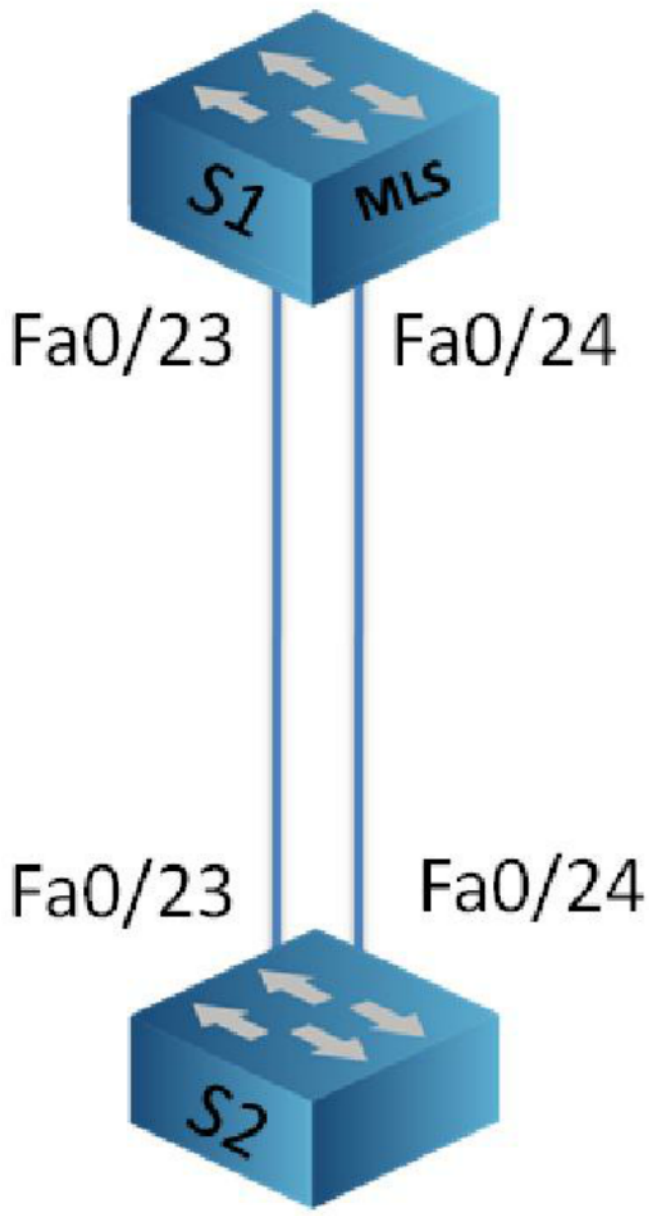
Interface	Role	Sts	Cost	Prio.Nbr	Type
Po1	Desg	FWD	19	128.65	P2p

LAB 14: PAgP (Port Aggregation Protocol)

OBJECTIVE:

To configure a dynamic Ether Channel using Port Aggregation protocol (PagP – Cisco Proprietary)

TOPOLOGY:



TASK:

1) Configure Ether channel between SW1 and SW2 using PAgP
2) Verify the output

STEPS:

1) Configure Etherchannel in Switch1 and Switch 2 with PAgP.

Switch1(config)# interface range fastethernet 0/23-24
Switch1(config-if)# switchport mode trunk
Switch1(config-if)# channel-group 1 protocol pagp
Switch1(config-if)# channel-group 1 mode desirable
Switch2(config)# interface range fastethernet 0/23-24
Switch2(config-if)# switchport mode trunk

Switch2(config-if)# channel-group 1 protocol pagp
Switch2(config-if)# channel-group 1 mode auto

VERIFICATION:

Switch1#show etherchannel load-balance
EtherChannel Load-Balancing Configuration:
src-mac
EtherChannel Load-Balancing Addresses Used Per-Protocol:
Non-IP: Source MAC address
IPv4: Source MAC address
IPv6: Source MAC address

Switch1#show etherchannel summary
Flags: D - down P - bundled in port-channel
I - stand-alone s - suspended
H - Hot-standby (LACP only)
R - Layer3 S - Layer2
U - in use f - failed to allocate aggregator
M - not in use, minimum links not met
u - unsuitable for bundling
w - waiting to be aggregated
d - default port
Number of channel-groups in use: 1
Number of aggregators: 1
Group Port-channel Protocol Ports
------+-------------+-----------+-----------------------------------
1 Po1(SU) PAgP Fa0/22(P) Fa0/23(P)

Switch1#show interfaces port-channel 1
Port-channel1 is up, line protocol is up (connected)
Hardware is EtherChannel, address is 001a.e3ee.f499 (bia 001a.e3ee.f499)
MTU 1500 bytes, BW 200000 Kbit, DLY 100 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
Keepalive set (10 sec)
Full-duplex, 100Mb/s, link type is auto, media type is unknown
input flow-control is off, output flow-control is unsupported
Members in this channel: Fa0/22 Fa0/23
ARP type: ARPA, ARP Timeout 04:00:00
Last input 00:00:01, output 00:00:00, output hang never
Last clearing of "show interface" counters never
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
2965 packets input, 270564 bytes, 0 no buffer
Received 4901 broadcasts (2248 multicasts)
0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored

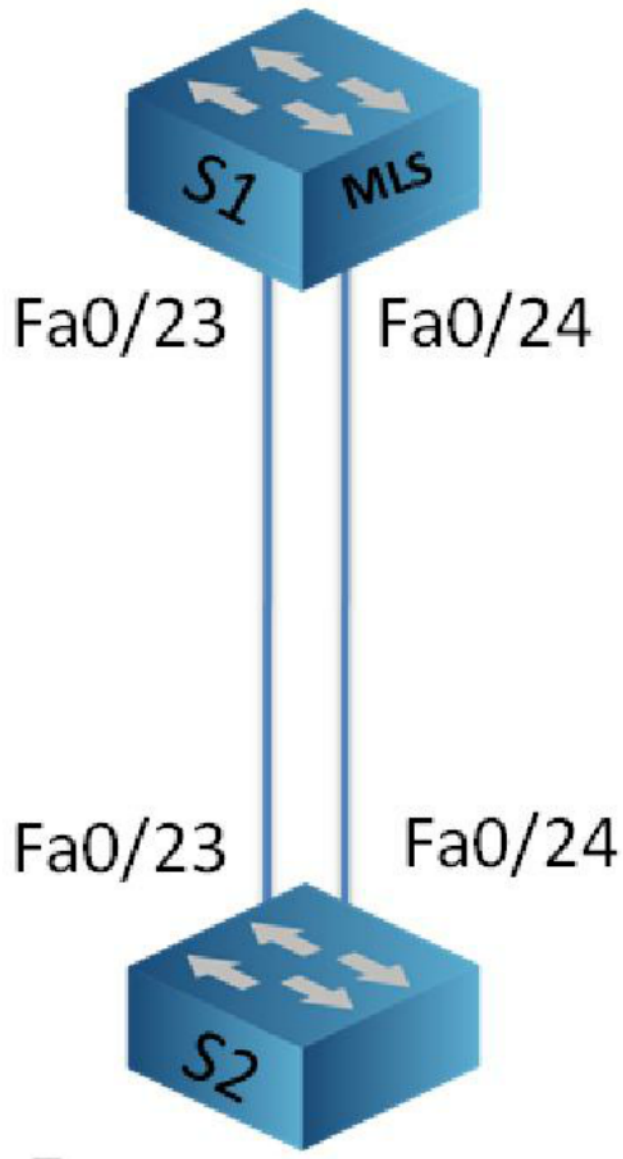
```
     0 watchdog, 2248 multicast, 0 pause input
     0 input packets with dribble condition detected
     3945 packets output, 340417 bytes, 0 underruns
     0 output errors, 0 collisions, 10 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
Switch2 #show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        u - unsuitable for bundling
        U - in use      f - failed to allocate aggregator
        d - default port
Number of channel-groups in use: 1
Number of aggregators:          1
Group  Port-channel  Protocol    Ports
------+-------------+-----------+-------------------------------
1      Po1(SU)         PAgP      Fa0/22(P)   Fa0/23(Pd)
```

LAB 15: LACP – Link Aggregation Control Protocol

OBJECTIVE:

To configure a dynamic Ether Channel using LACP (IEEE Open Standard)

TOPOLOGY:



TASK:

1) Configure Ether channel between SW1 and SW2 using LACP
2) Verify the output

STEPS:

1) Configure Ether channel in Switch1 and Switch 2.

```
Switch1(config)# interface range fastethernet 0/23-24
Switch1(config-if)# switchport mode trunk
Switch1(config-if)# channel-group 1 protocol lacp
Switch1(config-if)# channel-group 1 mode active
Switch2(config)# interface range fastethernet 0/23-24
Switch2(config-if)# switchport mode trunk
Switch2(config-if)# channel-group 1 protocol lacp
Switch2(config-if)# channel-group 1 mode passive
```

VERIFICATION:

Switch1#show etherchannel summary

```
Flags:  D - down        P - bundled in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port
Number of channel-groups in use: 1
Number of aggregators:          1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1      Po1(SU)         LACP      Fa0/22(P)   Fa0/23(P)
```

Switch1#show interfaces port-channel 1

```
Port-channel1 is up, line protocol is up (connected)
  Hardware is EtherChannel, address is 001a.e3ee.f499 (bia 001a.e3ee.f499)
  MTU 1500 bytes, BW 200000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, link type is auto, media type is unknown
  input flow-control is off, output flow-control is unsupported
  Members in this channel: Fa0/22 Fa0/23
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:01, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     2965 packets input, 270564 bytes, 0 no buffer
     Received 4901 broadcasts (2248 multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 2248 multicast, 0 pause input
     0 input packets with dribble condition detected
     3945 packets output, 340417 bytes, 0 underruns
     0 output errors, 0 collisions, 10 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
```

Switch2 #show etherchannel summary

```
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
```

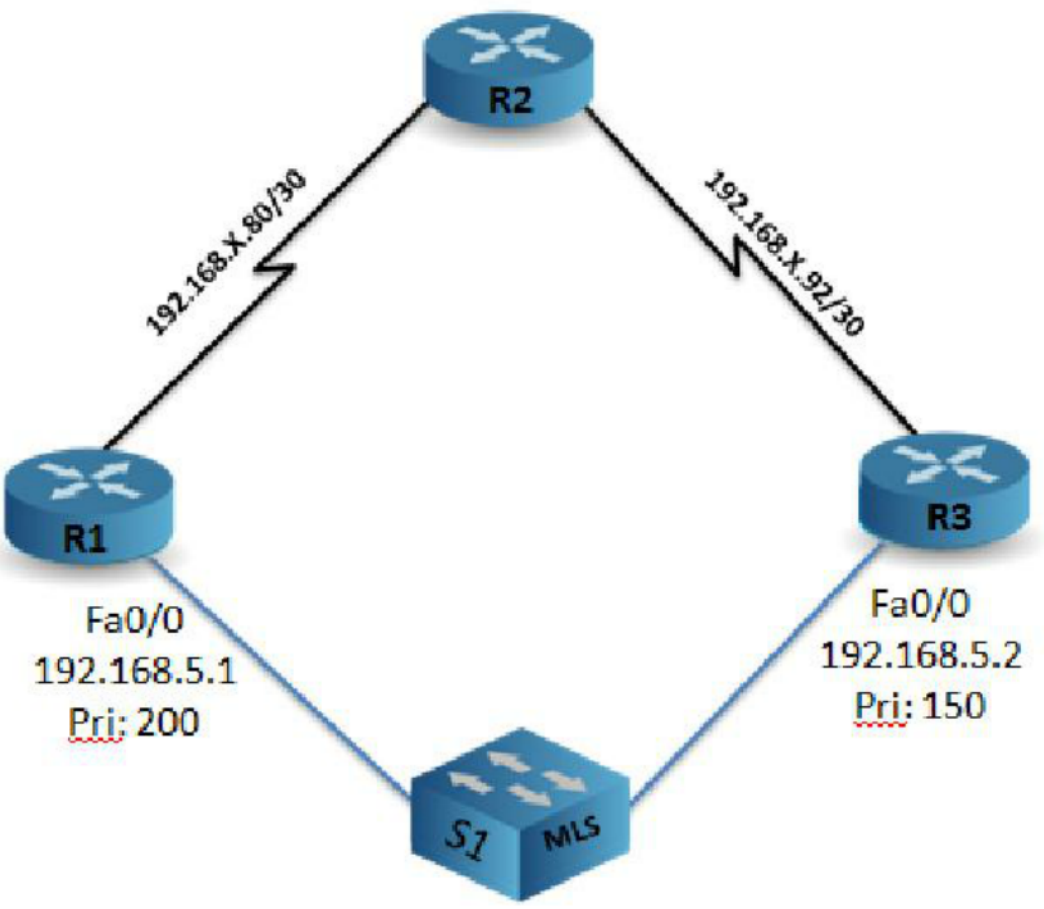
```
        R - Layer3     S - Layer2
        u - unsuitable for bundling
        U - in use     f - failed to allocate aggregator
        d - default port
Number of channel-groups in use: 1
Number of aggregators:          1
Group  Port-channel  Protocol    Ports
------+-------------+-----------+-------------------------------
1      Po1(SU)         Lacp      Fa0/22(P)   Fa0/23(Pd)
```

LAB 16: HSRP- Hot Standby Routing Protocol

OBJECTIVE:

To configure and verify Default Gateway Redundancy by using HSRP(Cisco Proprietary)

TOPOLOGY:



TASK:

1) Configure HSRP between R1 and R3 routers to achieve default gateway redundancy
2) Make R1 router as Active Router by giving it a priority 200and R3 router as Standby Router by setting its priority to 150.
3) Verify that R3 becomes the gateway in case the connectivity to R1 is lost

STEPS:

1) Configure IP address on LAN Interface of the R2 and R4 router.

```
R1(config)#interface fa0/0
R1(config-if)#ip address 192.168.5.1 255.255.255.0
R1(config-if)#no shutdown
R3(config)#interface fa 0/0
R3(config-if)#ip address 192.168.5.2 255.255.255.0
R3(config-if)#no shutdown
R3(config-if)#exit
```

2) Make R1 router as active router and R3 router as standby router.

```
R1(config)# interface fastethernet 0/0
R1(config-if)# standby 10 ip 192.168.5.3
R1(config-if)# standby 10 priority 200
R1(config-if)# standby 10 preempt
R1(config-if)# exit
R3(config)# interface fastethernet 0/0
R3(config-if)# standby 10 ip 192.168.5.3
R3(config-if)# standby 10 priority 150
R3(config-if)# standby 10 preempt
R3(config-if)# exit
```

VERIFICATION:

```
R1#show standby
FastEthernet0/0 - Group 10
State is Active
2 state changes, last state change 00:00:14
Virtual IP address is 192.168.5.3
Active virtual MAC address is 0000.0c07.ac0a
Local virtual MAC address is 0000.0c07.ac0a (v1 default)
Hello time 3 sec, hold time 10 sec
Next hello sent in 0.207 secs
Preemption enabled
Active router is local
Standby router is 192.168.5.2, priority 150 (expires in 7.764 sec)
Priority 200 (configured 200)
IP redundancy name is "hsrp-Fa0/0-10" (default)
```

```
R3#show standby
Ethernet0/0 - Group 10
Local state is Standby, priority 150, may preempt
Hellotime 3 holdtime 10
Next hello sent in 00:00:01.119
Hot standby IP address is 192.168.5.3 configured
Active router is 192.168.5.1 expires in 00:00:07, priority 200
Standby router is local
4 state changes, last state change 00:04:25
```

Shut down the interfaces of the active (R1) router and verify which router now becomes the active router.

```
R3#show standby
Ethernet0/0 - Group 10
Local state is Active, priority 150, may preempt
Hellotime 3 holdtime 10
Next hello sent in 00:00:02.426
Hot standby IP address is 192.168.5.3 configured
Active router is local
```

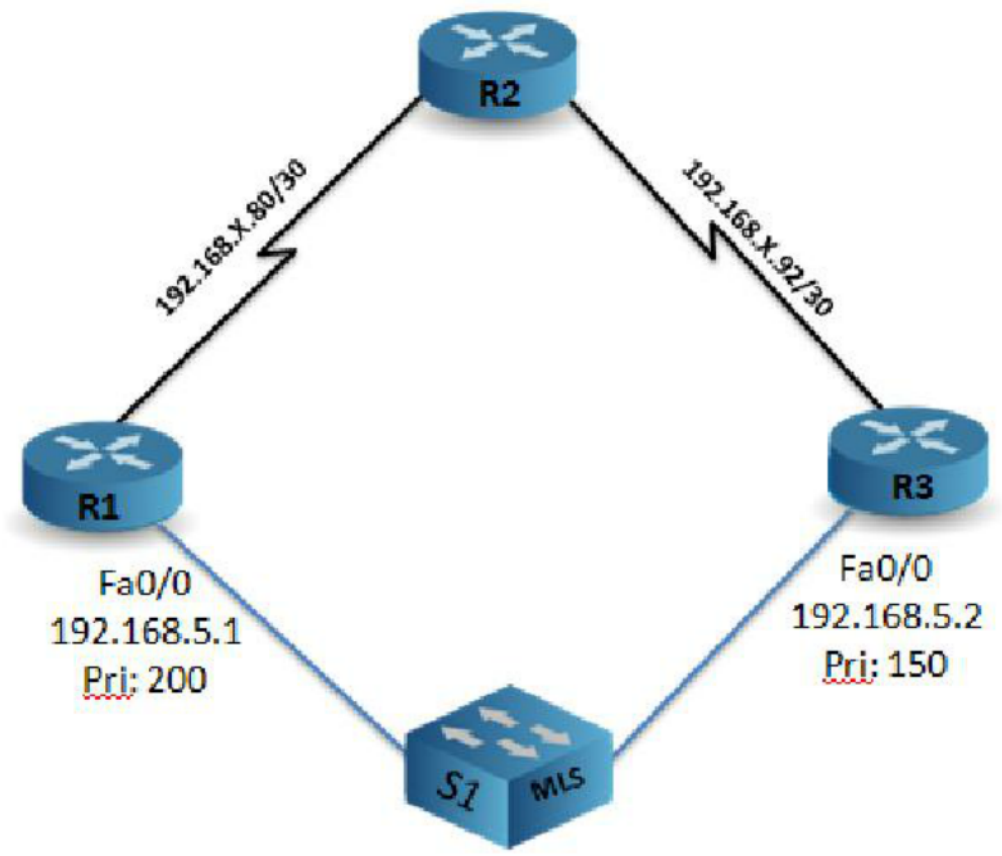
```
Standby router is unknown expired
Standby virtual mac address is 0000.0c07.ac0a
5 state changes, last state change 00:00:19
```

LAB 17: VRRP – Virtual Router Redundancy Protocol

OBJECTIVE:

To configure and verify Default Gateway Redundancy by using VRRP (IEEE Open standard)

TOPOLOGY:



TASK:

1) Configure VRRP between R1 and R3 routers to achieve default gateway redundancy
2) Make R1 router as Master Router by giving it a higher priority and R3 router as Backup Router by giving it a lower priority.
3) Verify that R3 becomes the default gateway in case R1 becomes unavailable.

STEPS:

1) Configure IP address on LAN Interface of the R1 and R3 router as done in previous lab.
2) Make R1 router as Master router (priority 200) and R3 router (priority 150) as Backup router.

```
R1(config)# interface fasteternet 0/0
R1(config-if)#vrrp 10 ip 192.168.5.3
R1(config-if)#vrrp 10 priority 200
R1(config-if)#exit
R3(config)# interface fasteternet 0/0
R3(config-if)#vrrp 10 ip 192.168.5.3
R3(config-if)#vrrp 10 priority 150
R3(config-if)#exit
```

VERIFICATION:

R1#show vrrp

```
FastEthernet0/0 - Group 10
State is Master
Virtual IP address is 192.168.5.3
  Virtual MAC address is 0000.5e00.010a
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 200
Master Router is 192.168.5.1 (local), priority is 200
  Master Advertisement interval is 1.000 sec
  Master Down interval is 3.218 sec
```

R1#show vrrp brief

```
Interface        Grp Pri Time  Own Pre State   Master addr     Group addr
Fa0/0            10  200 3218      Y  Master  192.168.5.1     192.168.5.3
```

R3#show vrrp

```
FastEthernet0/0 - Group 10
  State is Backup
  Virtual IP address is 192.168.5.3
  Virtual MAC address is 0000.5e00.010a
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 150
  Master Router is 192.168.5.1, priority is 200
  Master Advertisement interval is 1.000 sec
  Master Down interval is 3.414 sec (expires in 2.885 sec)
```

R3#sh vrrp brief

```
Interface        Grp Pri Time  Own Pre State   Master addr     Group addr
Fa0/0                10  150 3414      Y  Backup  192.168.5.1     192.168.5.3
```

Shut down the interfaces of the Master (R1) router and verify which router now becomes the Master router.

R3#show vrrp

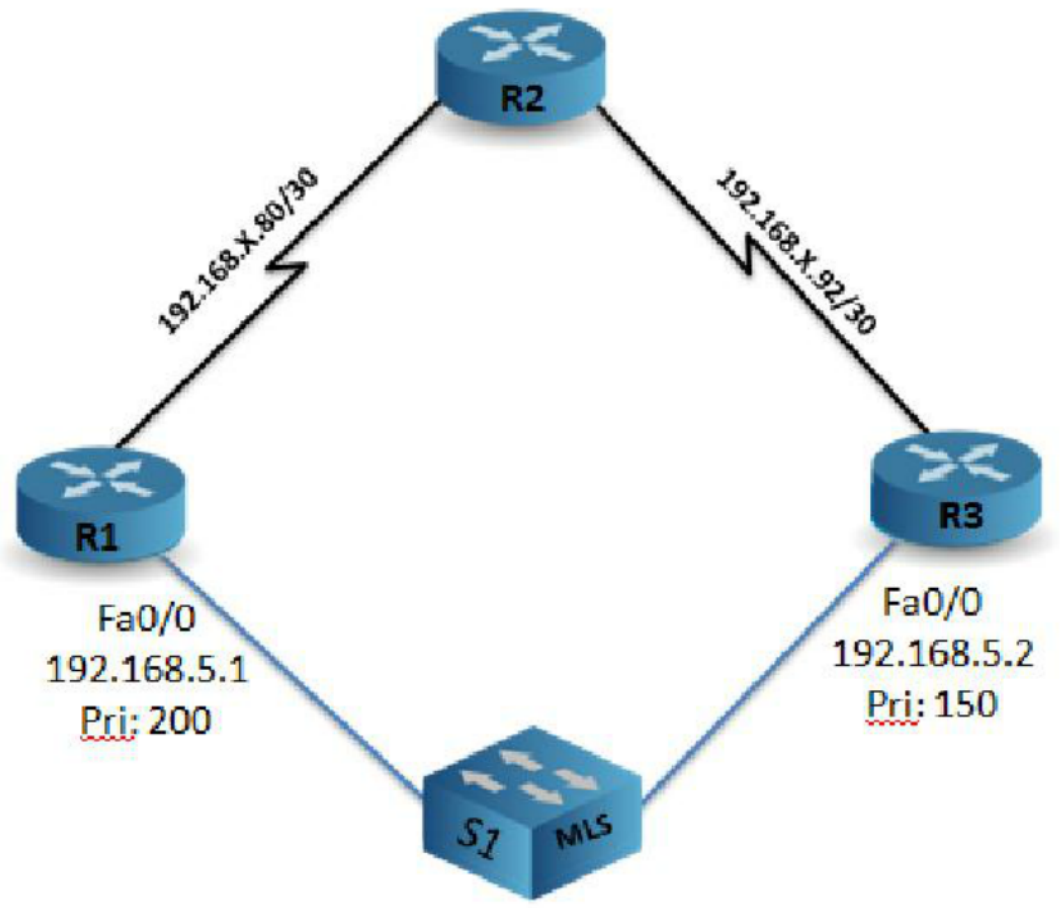
```
FastEthernet0/0 - Group 10
State is Master
Virtual IP address is 192.168.5.3
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 150
Master Router is 192.168.5.2 (local), priority is 150
Master Advertisement interval is 1.000 sec
Master Down interval is 3.218 sec
```

LAB 18: GLBP –Gateway Load Balancing protocol

OBJECTIVE :

To configure and verify Default Gateway Redundancy and load balancing by using GLBP

TOPOLOGY:



TASK:

1) Configure GLBP between R1 and R3 routers to achieve default gateway redundancy and load balancing
2) Make R1 the primary gateway by increasing its priority and R3 the standby by giving it a lower priority.
3) Verify that R3 takes over in case R1 becomes unavailable

STEPS:

1) Configure IP address on LAN Interface of the R1 and R3 router as done in previous lab.
2) Configure GLBP in R1 (priority 200) and R3 routers (priority 150)

```
R1(config)#interface fa0/0
R1(config-if)#ip address 192.168.5.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#glbp 10 ip 192.168.5.3
```

```
R1(config-if)#glbp 10 priority 200
R1(config-if)#exit
R3(config)#interface fa 0/0
R3(config-if)#ip address 192.168.5.2 255.255.255.0
R3(config-if)#no shut
R3(config-if)#glbp 10 ip 192.168.5.3
R3(config-if)#glbp 10 priority 150
R3(config-if)#glbp  10 preempt
R3(config-if)#exit
```

VERIFICATION:

```
R1#show glbp
FastEthernet0/0 - Group 10
  State is Active
    2 state changes, last state change 00:02:00
Virtual IP address is 192.168.5.3
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.852 secs
  Redirect time 600 sec, forwarder time-out 14400 sec
  Preemption disabled
Active is local
  Standby is 192.168.5.2, priority 150 (expires in 8.638 sec)
  Priority 200 (configured)
  Weighting 100 (default 100), thresholds: lower 1, upper 100
  Load balancing: round-robin
  Group members:
    000f.90bb.96c0 (192.168.5.1) local
    0011.928f.68e0 (192.168.5.2)
  There are 2 forwarders (1 active)
  Forwarder 1
    State is Active
      1 state change, last state change 00:01:50
    MAC address is 0007.b400.0a01 (default)
    Owner ID is 000f.90bb.96c0
    Redirection enabled
    Preemption enabled, min delay 30 sec
    Active is local, weighting 100
  Forwarder 2
    State is Listen
    MAC address is 0007.b400.0a02 (learnt)
    Owner ID is 0011.928f.68e0
    Redirection enabled, 599.936 sec remaining (maximum 600 sec)
    Time to live: 14399.932 sec (maximum 14400 sec)
    Preemption enabled, min delay 30 sec
    Active is 192.168.5.2 (primary), weighting 100 (expires in 9.932 sec)
R3#show glbp
FastEthernet0/0 - Group 10
  State is Standby
    1 state change, last state change 00:00:10
  Virtual IP address is 192.168.5.3
```

```
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.782 secs
  Redirect time 600 sec, forwarder time-out 14400 sec
  Preemption enabled, min delay 0 sec
Active is 192.168.5.1, priority 200 (expires in 6.991 sec)
  Standby is local
  Priority 150 (configured)
  Weighting 100 (default 100), thresholds: lower 1, upper 100
  Load balancing: round-robin
  Group members:
    000f.90bb.96c0 (192.168.5.1)
    0011.928f.68e0 (192.168.5.2) local
  There are 2 forwarders (1 active)
  Forwarder 1
    State is Listen
    MAC address is 0007.b400.0a01 (learnt)
    Owner ID is 000f.90bb.96c0
    Time to live: 14396.987 sec (maximum 14400 sec)
    Preemption enabled, min delay 30 sec
    Active is 192.168.5.1 (primary), weighting 100 (expires in 9.888 sec)
  Forwarder 2
    State is Active
      1 state change, last state change 00:00:38
    MAC address is 0007.b400.0a02 (default)
    Owner ID is 0011.928f.68e0
    Preemption enabled, min delay 30 sec
    Active is local, weighting 100
```

Load Balancing in GLBP

PCA>tracert 8.8.8.8

Tracing route to 8.8.8.8 over a maximum of 30 hops:

1 12 ms 0 ms 0 ms 192.168.5.1
2 * 0 ms 0 ms 8.8.8.8

PCB>tracert 8.8.8.8

Tracing route to 8.8.8.8 over a maximum of 30 hops:

1 12 ms 0 ms 0 ms 192.168.5.2
2 * 0 ms 0 ms 8.8.8.8

LAB 19: VACL – VLAN Access List

OBJECTIVE:

To configure VLAN Access list to filter traffic within a VLAN

TOPOLOGY:

TASK:

1) Verify that two PCs on the same VLAN can ping each other
2) Configure VACL to stop the communication between the two PC's.
3) Verify that communication is no longer possible.

STEPS:

1) Ping from PC1 to PC2

```
PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

Reply from 192.168.0.103: bytes=32 time=2ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
```

Ping statistics for 192.168.0.103:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 2ms, Average = 0ms

2) Configure VLAN access filter on SW1 to drop icmp echo requests from PC1 to PC2

SW1(config)#access-list 110 permit icmp host 192.168.0.3 host 192.168.0.203 echo
SW1(config)#VLAN access-map zoom 10
SW1(config-access-map)#match ip address 110
SW1(config-access-map)#action drop
SW1(config-access-map)#exit
SW1(config)#VLAN access-map zoom 20
SW1(config-access-map)#exit

3) Apply the VACL

SW1(config)#VLAN filter zoom VLAN-list 10

VERIFICATION:

SW1#Show VLAN access-map
VLAN access-map "zoom" 10
Match clauses:
ip address: 110
Action: drop
VLAN access-map "zoom" 20
Match clauses:
Action:Forward

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.0.103:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

LAB 20: Port Security

OBJECTIVE:

To configure Port Security on a switch by binding the MAC-address of a PC to a particular port

TOPOLOGY:

TASK:

1) Configure Port Security
2) Verify that the switch will not forward frames if any other PC is connected

STEPS:

1) Configure Port Security on the interface where your pc is connected and enter your own MAC address

```
SW1(config)#interface fa 0/12
SW1(config-if)#switchport mode access
SW1(config-if)#switchport port-security
SW1(config-if)#switchport port-security mac-address xxxx.xxxx.xxxx
SW1(config-if)#switchport port-security violation shutdown
```

VERIFICATION:

➔ **Before connecting other pc to the port**

SW1#show interfaces status

Port	Name	Status	VLAN	Duplex	Speed	Type
Fa0/1		connected	1	a-full	a-100	10/100BaseTX
Fa0/2		connected	1	a-full	a-100	10/100BaseTX
Fa0/3		connected	1	a-full	a-100	10/100BaseTX
Fa0/4		notconnect	1	auto	auto	10/100BaseTX
Fa0/5		notconnect	1	auto	auto	10/100BaseTX
Fa0/6		notconnect	1	auto	auto	10/100BaseTX
Fa0/7		notconnect	1	auto	auto	10/100BaseTX
Fa0/8		connected	1	a-half	a-10	10/100BaseTX
Fa0/9		notconnect	1	auto	auto	10/100BaseTX
Fa0/10		notconnect	1	auto	auto	10/100BaseTX
Fa0/11		connected	1	a-full	a-100	10/100BaseTX
Fa0/12		connected	1	a-full	a-100	10/100BaseTX
Fa0/13		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/14		notconnect	1	auto	auto	10/100BaseTX
Fa0/15		notconnect	1	auto	auto	10/100BaseTX
Fa0/16		notconnect	1	auto	auto	10/100BaseTX
Fa0/17		notconnect	1	auto	auto	10/100BaseTX
Fa0/18		notconnect	1	auto	auto	10/100BaseTX
Fa0/19		notconnect	1	auto	auto	10/100BaseTX
Fa0/20		notconnect	1	auto	auto	10/100BaseTX
Fa0/21		notconnect	1	auto	auto	10/100BaseTX
Fa0/22		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/23		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/24		connected	trunk	a-full	a-100	10/100BaseTX
Gi0/1		notconnect	1	auto	auto	Not Present
Gi0/2		notconnect	1	auto	auto	Not Present

➔ **After connecting other pc to the port**

SW1#show interfaces status

Port	Name	Status	VLAN	Duplex	Speed	Type
Fa0/1		connected	1	a-full	a-100	10/100BaseTX
Fa0/2		connected	1	a-full	a-100	10/100BaseTX
Fa0/3		connected	1	a-full	a-100	10/100BaseTX
Fa0/4		notconnect	1	auto	auto	10/100BaseTX
Fa0/5		notconnect	1	auto	auto	10/100BaseTX
Fa0/6		notconnect	1	auto	auto	10/100BaseTX
Fa0/7		notconnect	1	auto	auto	10/100BaseTX
Fa0/8		err-disabled	1	a-half	a-10	10/100BaseTX
Fa0/9		notconnect	1	auto	auto	10/100BaseTX
Fa0/10		notconnect	1	auto	auto	10/100BaseTX
Fa0/11		connected	1	a-full	a-100	10/100BaseTX
Fa0/12		connected	1	a-full	a-100	10/100BaseTX

```
Fa0/13          connected   trunk       a-full  a-100 10/100BaseTX
Fa0/14          notconnect  1           auto    auto 10/100BaseTX
Fa0/15          notconnect  1           auto    auto 10/100BaseTX
Fa0/16          notconnect  1           auto    auto 10/100BaseTX
Fa0/17          notconnect  1           auto    auto 10/100BaseTX
Fa0/18          notconnect  1           auto    auto 10/100BaseTX
Fa0/19          notconnect  1           auto    auto 10/100BaseTX
Fa0/20          notconnect  1           auto    auto 10/100BaseTX
Fa0/21          notconnect  1           auto    auto 10/100BaseTX
Fa0/22          connected   trunk       a-full  a-100 10/100BaseTX
Fa0/23          connected   trunk       a-full  a-100 10/100BaseTX
Fa0/24          connected   trunk       a-full  a-100 10/100BaseTX
Gi0/1           notconnect  1           auto    auto Not Present
Gi0/2           notconnect  1           auto    auto Not Present
```

SW1#show port-security

```
Secure Port  MaxSecureAddr  CurrentAddr  SecurityViolation  Security Action
                (Count)       (Count)       (Count)
---------------------------------------------------------------------------
Fa0/8            1             1             1          Shutdown
---------------------------------------------------------------------------
Total Addresses in System (excluding one mac per port)     : 0
Max Addresses limit in System (excluding one mac per port) : 6144
```

SW1#show port-security int fa0/8

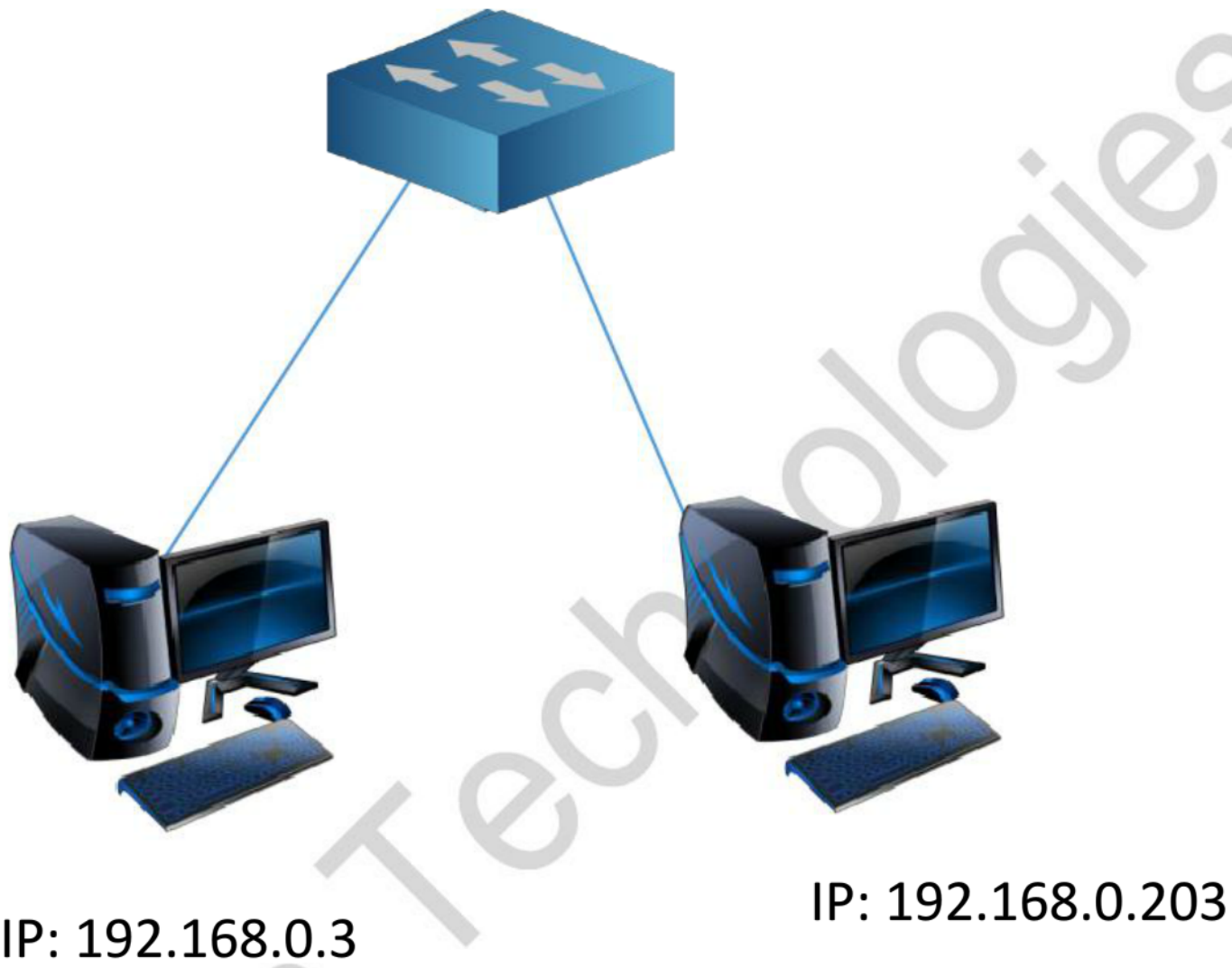
```
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 1
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:VLAN   : 00d0.586c.23e0:1
Security Violation Count   : 0
```

LAB 21: Private VLAN

OBJECTIVE:

To configure and verify the behavior of Private VLAN

TOPOLOGY:



TASK:

1) Configure Private VLANs such that PC1 and PC2 should not communicate with each other
2) Verify the output

STEPS:

1. Before configuring private VLANs, set the switch VTP mode to transparent mode.

   SW1(config)#vtp mode transparent

2. Create Primary private VLAN with the help of the following command.

   SW1(config)#VLAN 10
   SW1(config-VLAN)#private-VLAN primary

3. Create secondary private VLAN with the help of the following command.

   SW1(config)#VLAN 11
   SW1(config-VLAN)#private-VLAN isolated

4. Verify the communication between two PC's before assigning to private vlans.

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

Reply from 192.168.0.103: bytes=32 time=2ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.0.103:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 2ms, Average = 0ms

5. Now assign our pc ports that should not communicate with each other in the private isolated VLANs.

SW1(config)#interface fa0/2
SW1(config-if)#switchport mode private-VLAN host
SW1(config-if)# switchport private-VLAN host-association 10 11
SW1(config)#interface fa0/4
SW1(config-if)#switchport mode private-VLAN host
SW1(config-if)# switchport private-VLAN host-association 10 11

VERIFICATION:

SW1#show VLAN private-VLAN

Primary	Secondary	Type	Ports
10	11	isolated	Fa0/1, Fa0/2

After assigning ports to the private vlans.
PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

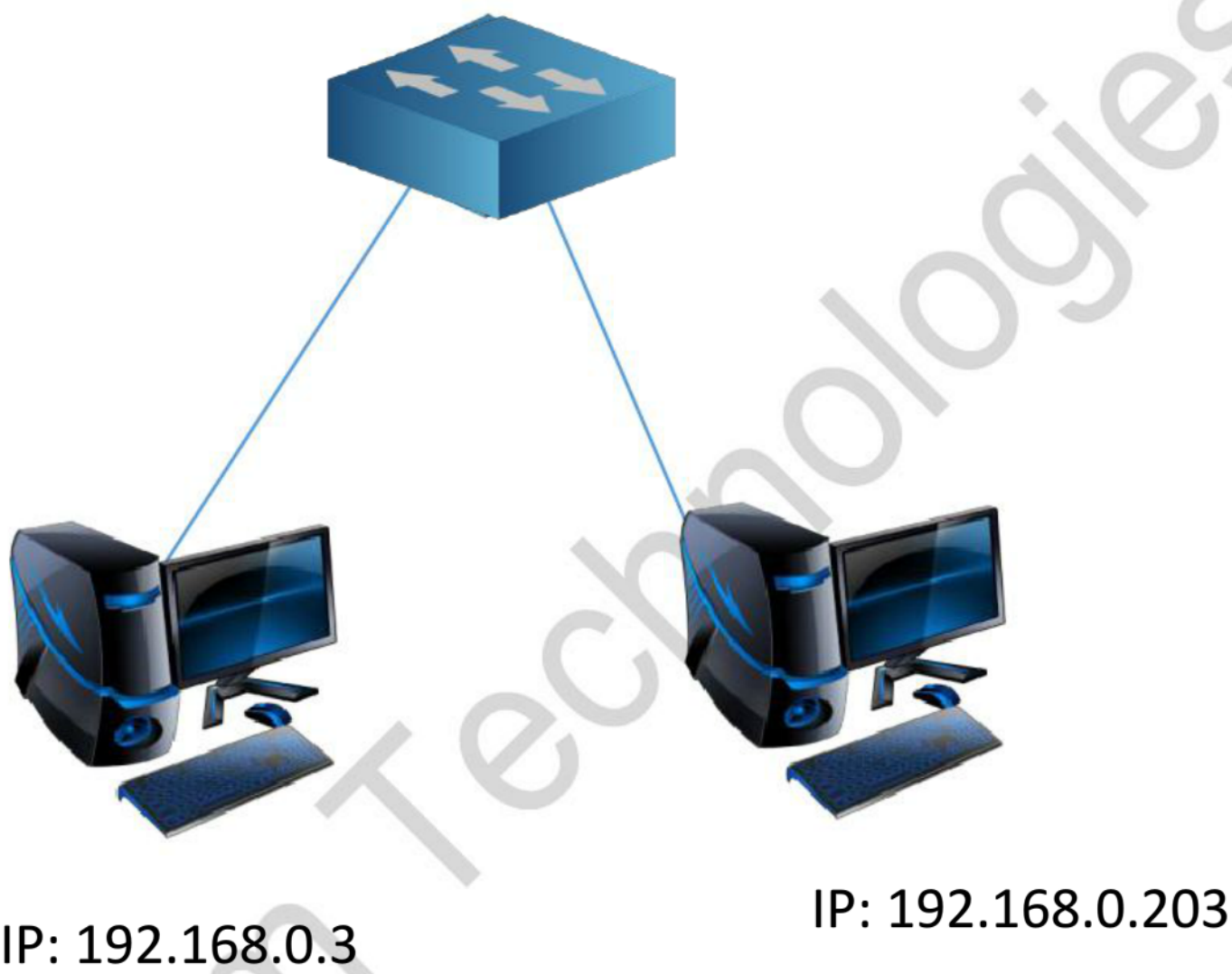
Ping statistics for 192.168.0.103:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

LAB 22: Protected Ports

OBJECTIVE:

To configure protected ports on a switch so that no layer 2 traffic is forwarded between protected ports with the help of a router/ multi layer switch.

TOPOLOGY:



TASK:

1) Configure Protected Ports such that PC1 and PC2 should not communicate with each other
2) Verify that communication is no longer possible

STEPS:

1) Ping from PC1 to PC2 and check that communication is possible

```
PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

Reply from 192.168.0.103: bytes=32 time=2ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
```

```
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.0.103:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

2) PC1 and PC2 should not communicate with each other as they are both on protected ports

```
SW1(config)#interface fa0/2
SW1(config-if)#switchport host
SW1(config-if)# switchport mode protected
SW1(config)#interface fa0/4
SW1(config-if)#switchport host
SW1(config-if)# switchport mode protected
```

VERIFICATION:

NOTE: Protected ports will not communicate with each other. But Protected to Unprotected and Unprotected to Protected ports will communicate with each other.

```
SW1#show interfaces fastEthernet 0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-VLAN host-association: none
Administrative private-VLAN mapping: 10 (ccna) 11 (VLAN0011) 12 (VLAN00
Administrative private-VLAN trunk native VLAN: none
Administrative private-VLAN trunk Native VLAN tagging: enabled
Administrative private-VLAN trunk encapsulation: dot1q
Administrative private-VLAN trunk normal VLANs: none
Administrative private-VLAN trunk associations: none
Administrative private-VLAN trunk mappings: none
Operational private-VLAN: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
```

➔ **Protected: true**

Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

SW1#show interfaces fastEthernet 0/2 switchport

Name: Fa0/2
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-VLAN host-association: 10 (ccna) 11 (VLAN0011)
Administrative private-VLAN mapping: none
Administrative private-VLAN trunk native VLAN: none
Administrative private-VLAN trunk Native VLAN tagging: enabled
Administrative private-VLAN trunk encapsulation: dot1q
Administrative private-VLAN trunk normal VLANs: none
Administrative private-VLAN trunk associations: none
Administrative private-VLAN trunk mappings: none
Operational private-VLAN: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL

➔ **Protected: true**

Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

After Configuring Protected Ports.

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

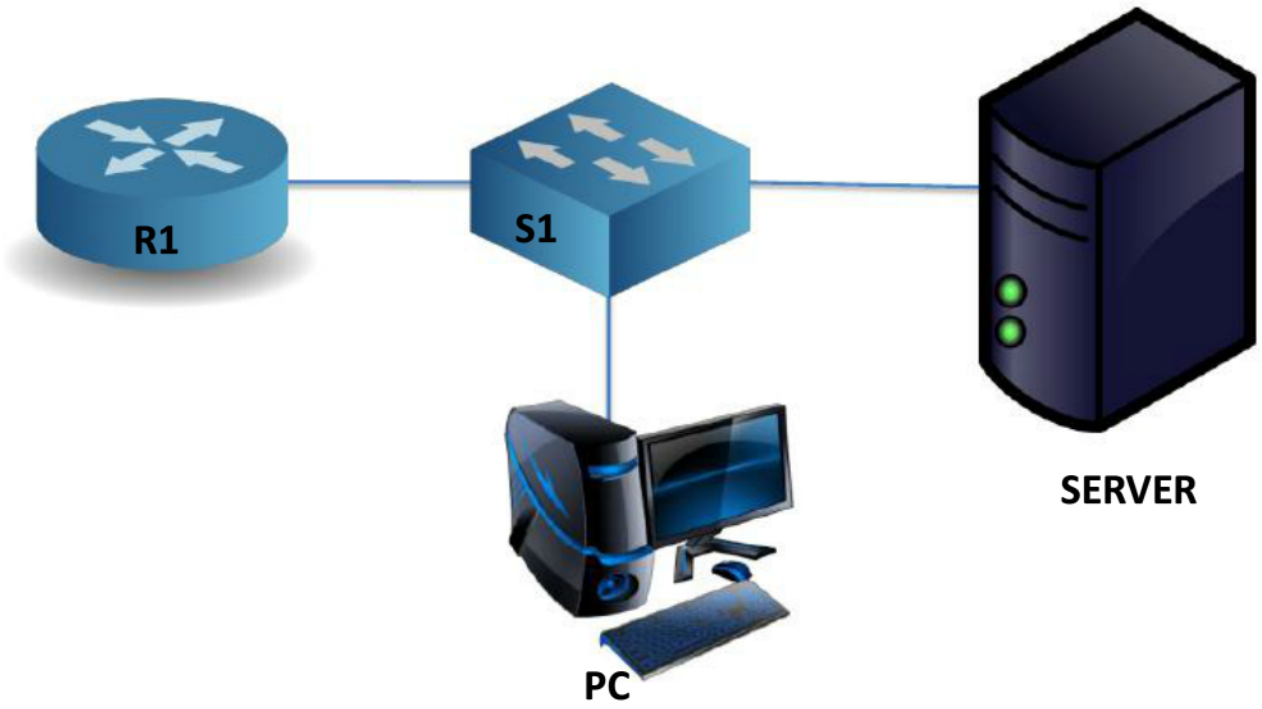
Ping statistics for 192.168.0.103:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)

LAB 23: AAA - Authentication Authorization Accounting

OBJECTIVE:

To configure an AAA (Authentication, Authorization and Accounting) server for the users on a network

TOPOLOGY:



TASK:

1) Configure AAA authentication on R1 by using a RADIUS server.
2) Verify that Telnet users are authenticated by the RADIUS server

STEPS:

1) Configure authentication in the router.

```
R1(config)#aaa new-model
R1(config)#aaa authentication login default group radius
R1(config)#radius-server host 192.168.0.1 key zoom123
R1(config-if)#exit
```

2) Implement Authentication on Console as well as vty lines.

```
R1(config)#line console 0
R1(config-line)#login authentication default
R1(config-line)#exit
R1(config)#line vty 0 4
R1(config-line)#login authentication default
```

R1(config-line)#exit

VERIFICATION:

Total sessions since last reload: 1
Session Id:1
Unique Id:1
User Name:zoom123
IP Address:192.168.0.3
Idle Time: CT Call Handle: 0

Router#debug aaa authentication
092852: Jan 27 22:19:06.713 CST: AAA/AUTHEN (543609479): status = GETPASS

092853: Jan 27 22:19:07.985 CST: AAA/AUTHEN/CONT (543609479): continue_login

(user='dial_tac')

!The NAS receives FAIL from the AAA server for the user.

092854: Jan 27 22:19:07.985 CST: AAA/AUTHEN (543609479): status = GETPASS

092855: Jan 27 22:19:07.985 CST: AAA/AUTHEN (543609479): Method=ADMIN (tacacs+)

092856: Jan 27 22:19:07.985 CST: TAC+: send AUTHEN/CONT packet id=543609479

092857: Jan 27 22:19:08.185 CST: TAC+: ver=192 id=543609479 received AUTHEN

status = FAIL

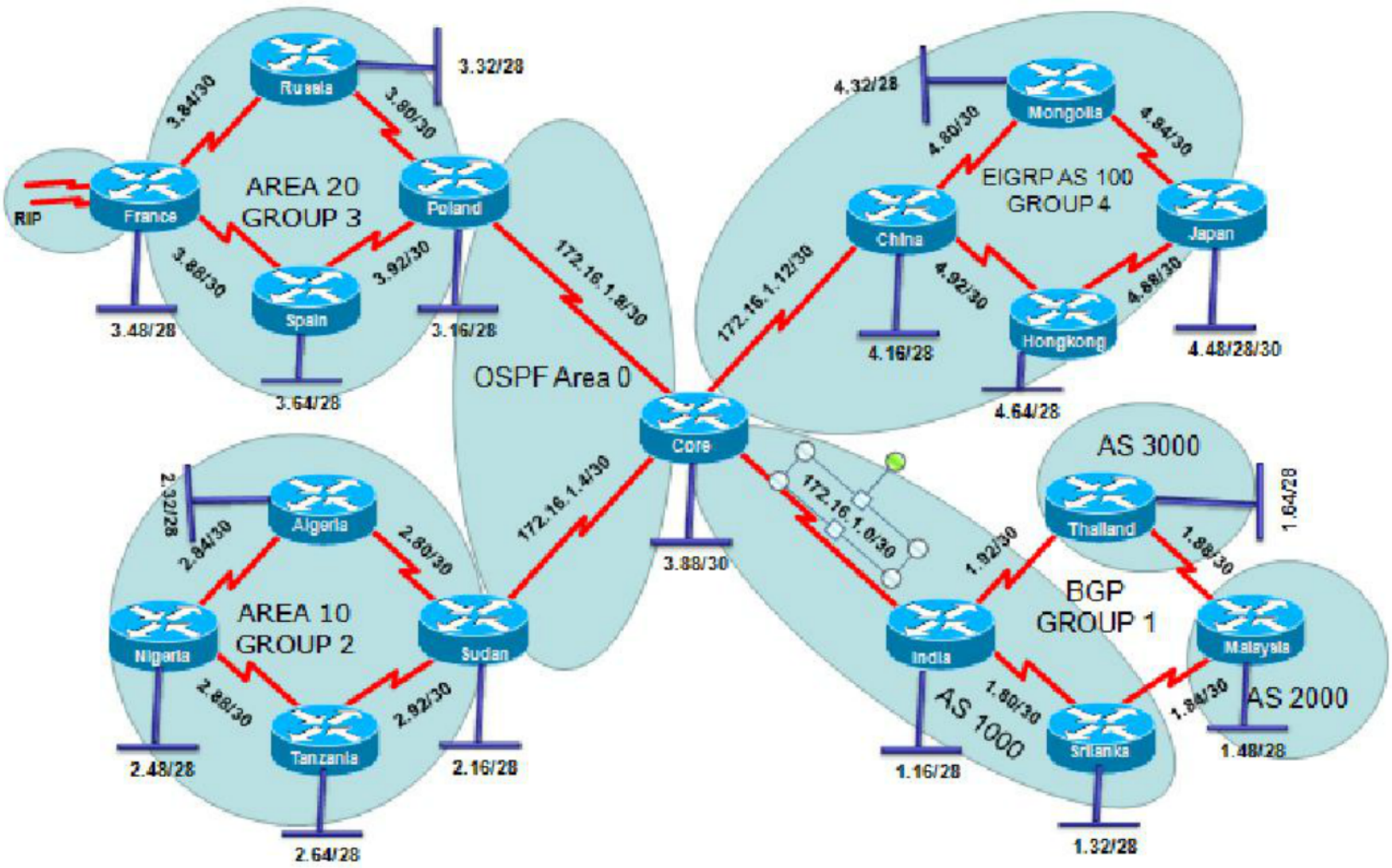
092858: Jan 27 22:19:08.185 CST: AAA/AUTHEN (543609479): status = FAIL
!The user session is torn down, and the AAA process is freed.

Troubleshooting Scenario

OBJECTIVE:

Troubleshoot the problems in every group.

TOPOLOGY:



TSHOOT TASKS: (Include loopback networks in Routing Protocol)

GROUP-1:

1. India should access loopback of Malaysia using one AS(Via Srilanka)
2. Srilanka should access loopback of Thailand using one AS(Via India)
3. All the routers should form neighborship using loopback address
4. Thailand should access 30.1.0.0 & 30.1.1.0 via 1.89 and 30.1.2.0 & 30.1.3.0 via 1.94

GROUP-2:

1. Area 10 should not receive External Networks and Summary Networks
2. Sudan and Tanzania should not become neighbours (using command)
3. Nigeria should ping to 30.4.1.1(JAPAN)
4. Configure Simple Password Authentication between Sudan and Algeria

GROUP-3:

1. Area 20 should not receive External Updates
2. Russia and Poland should not become neighbour (Do not remove WAN LINK network)
3. France should ping to 30.4.1.1 (Japan)
4. Configure MD5 Authentication between Poland and Core

GROUP-4:

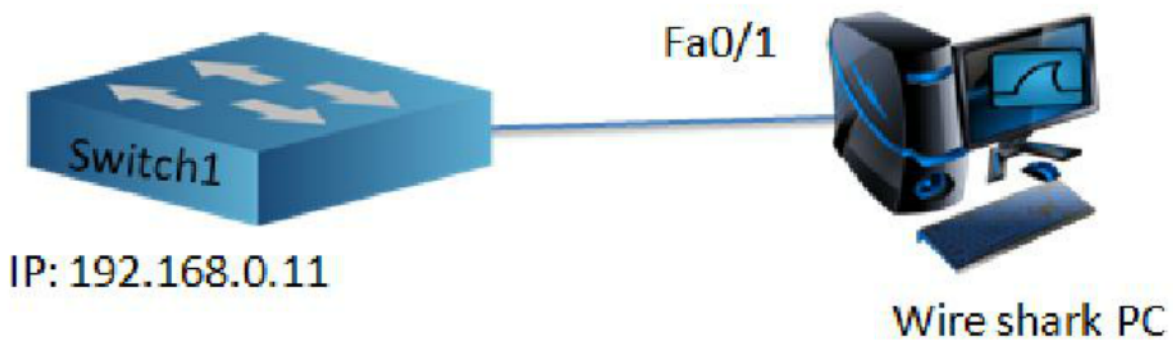
1. Form Neighbour relationship using Authentication (in all the routers)
2. Hongkong should not receive Update of Mongolia
3. Mongolia should ping to loopback of France
4. China shouldn't receive loopback of Sudan

LAB: Analyzing Packets Using Wireshark

OBJECTIVE:

Capture Telnet traffic to a switch using Wireshark

TOPOLOGY:

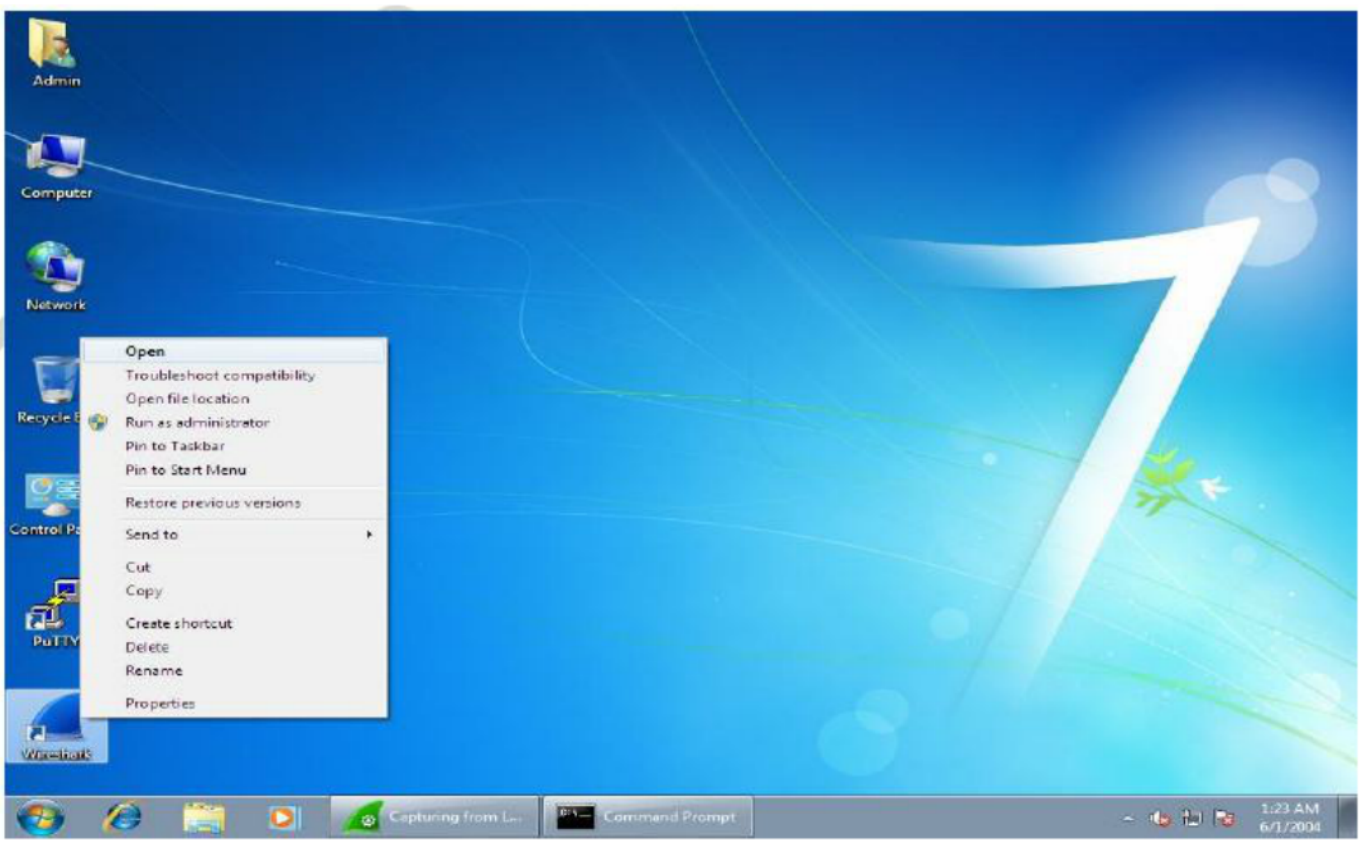


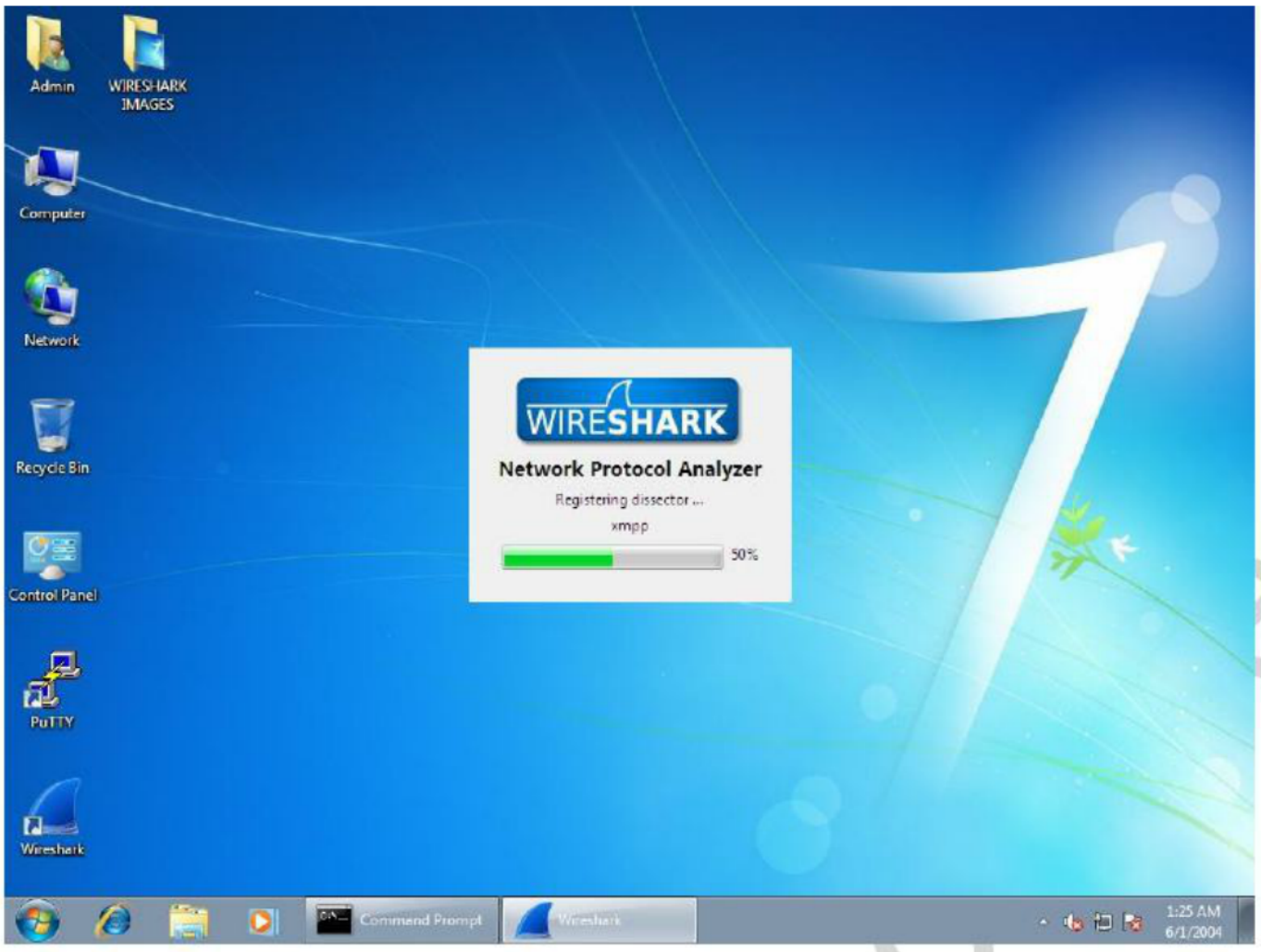
TASK:

1) Capture Telnet Traffic to a switch using Wireshark

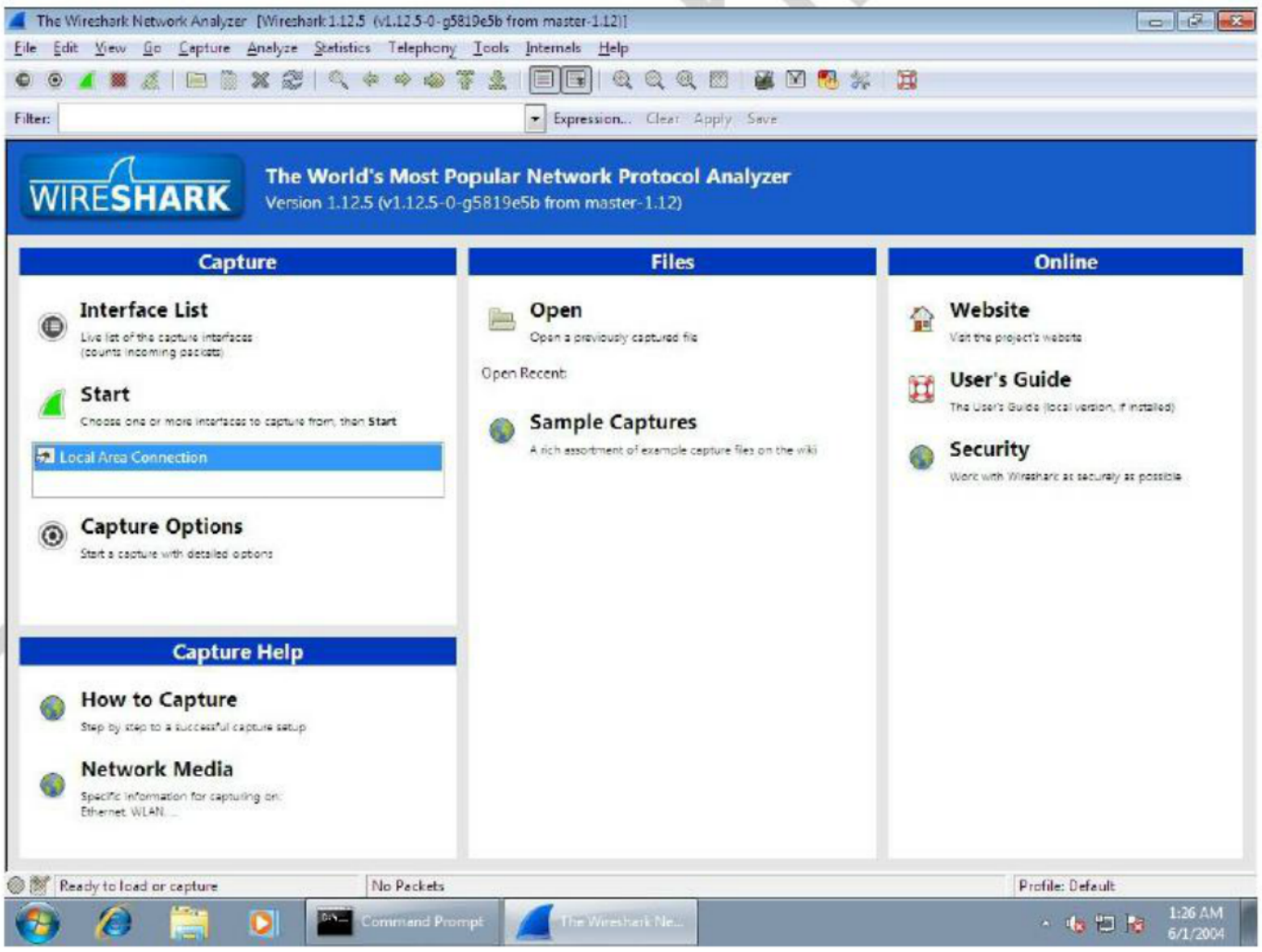
STEPS:

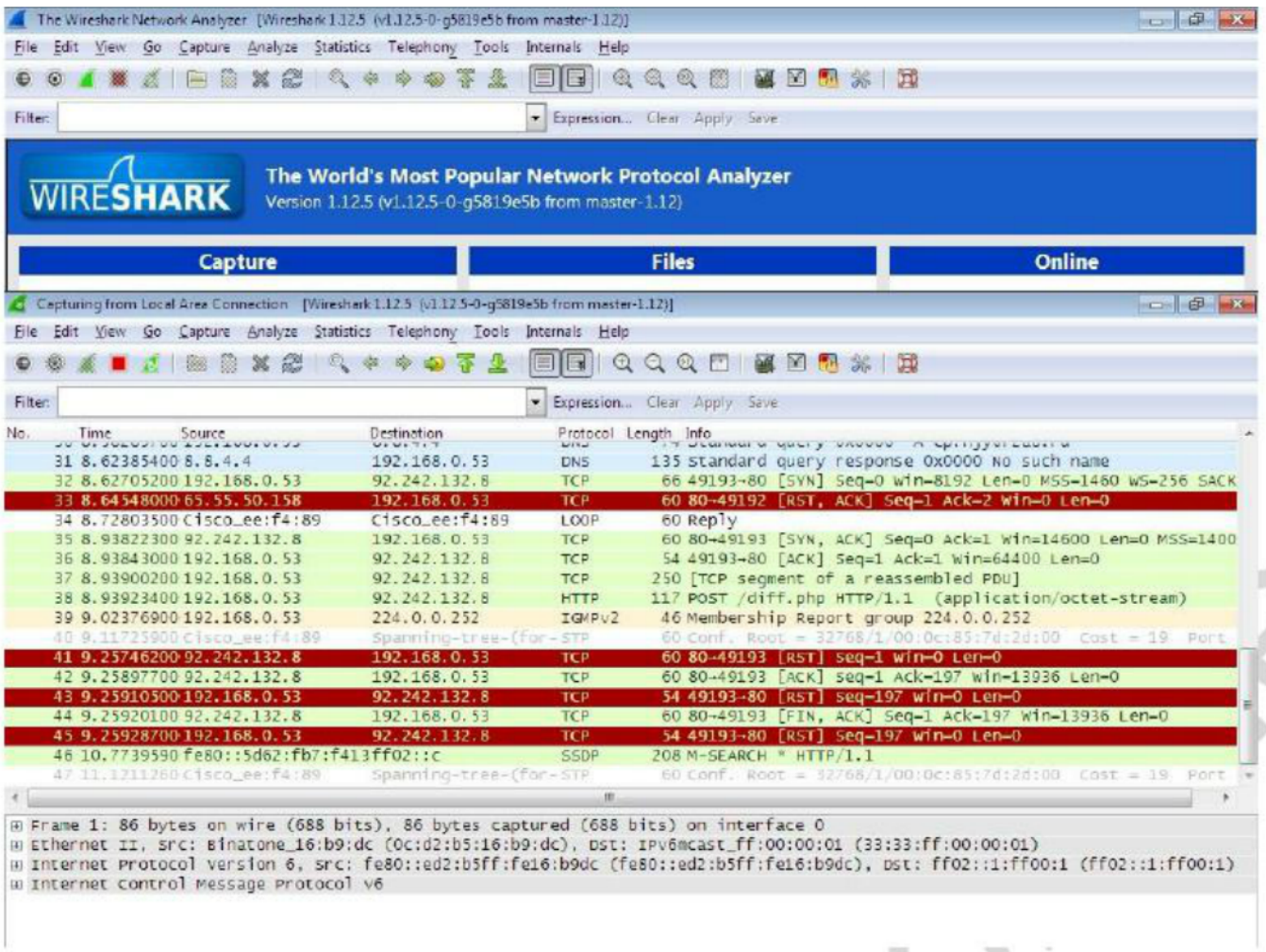
1) Open Wireshark in your pc.



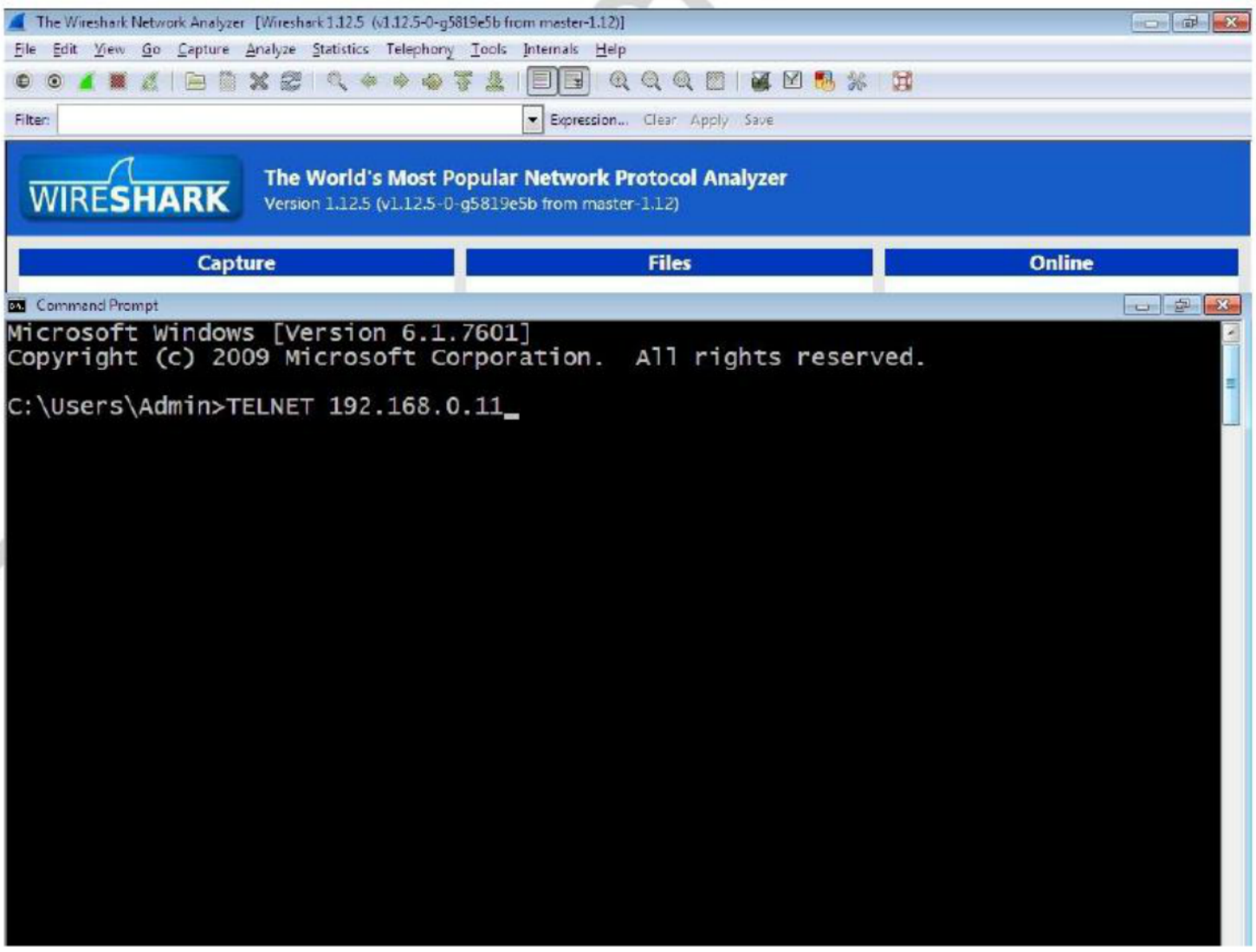


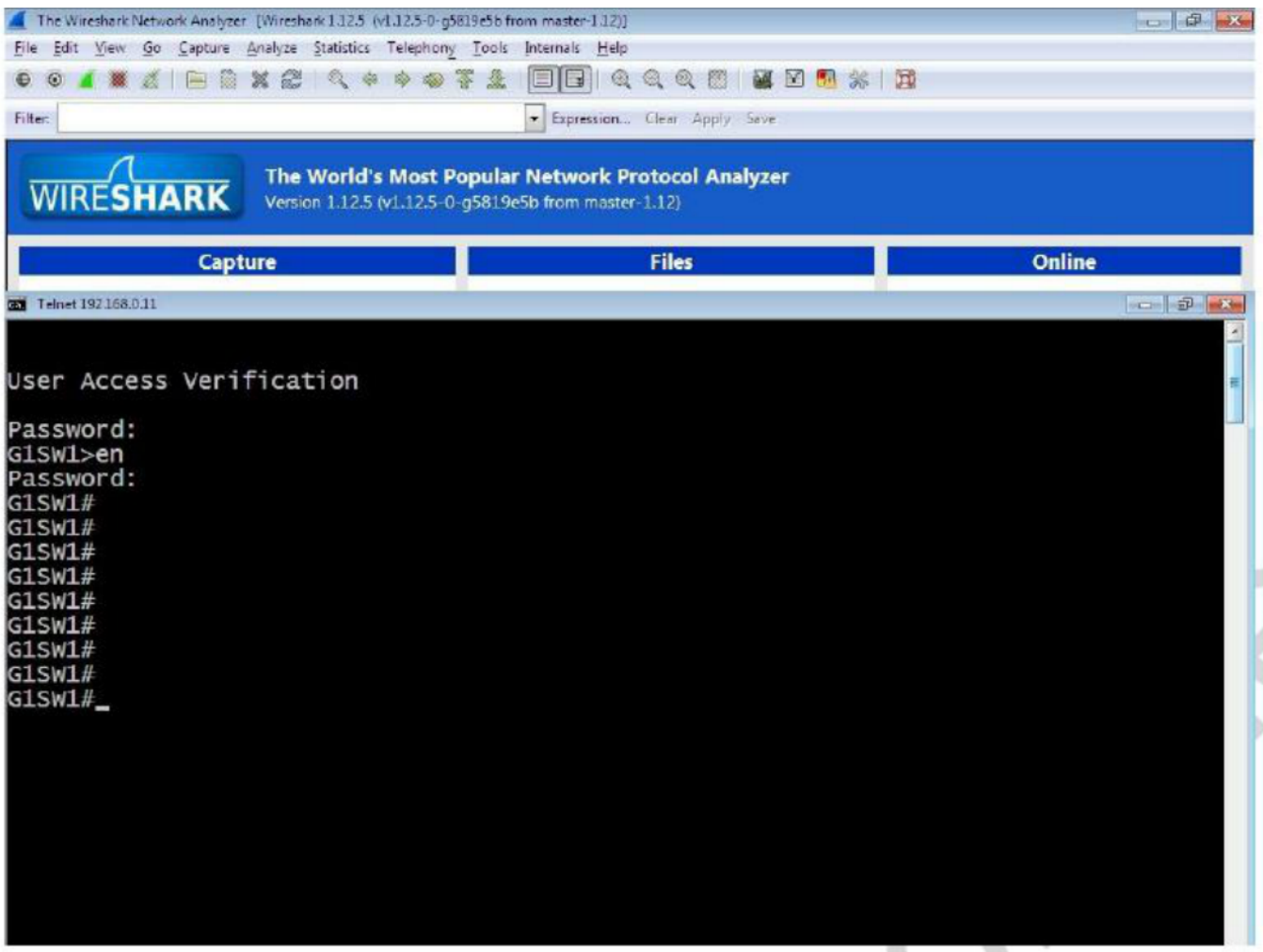
2) Select Local Area Connection and click on start to start capturing the packets





3) Open command prompt and telnet to switch and execute same commands on the switch.




The Wireshark Network Analyzer [Wireshark 1.12.5 (v1.12.5-0-g5819e5b from master-1.12)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
WIRESHARK
The World's Most Popular Network Protocol Analyzer
Version 1.12.5 (v1.12.5-0-g5819e5b from master-1.12)
Capture
Files
Online
Telnet 192.168.0.11
User Access Verification
Password:
G1SW1>en
Password:
G1SW1#
G1SW1#
G1SW1#
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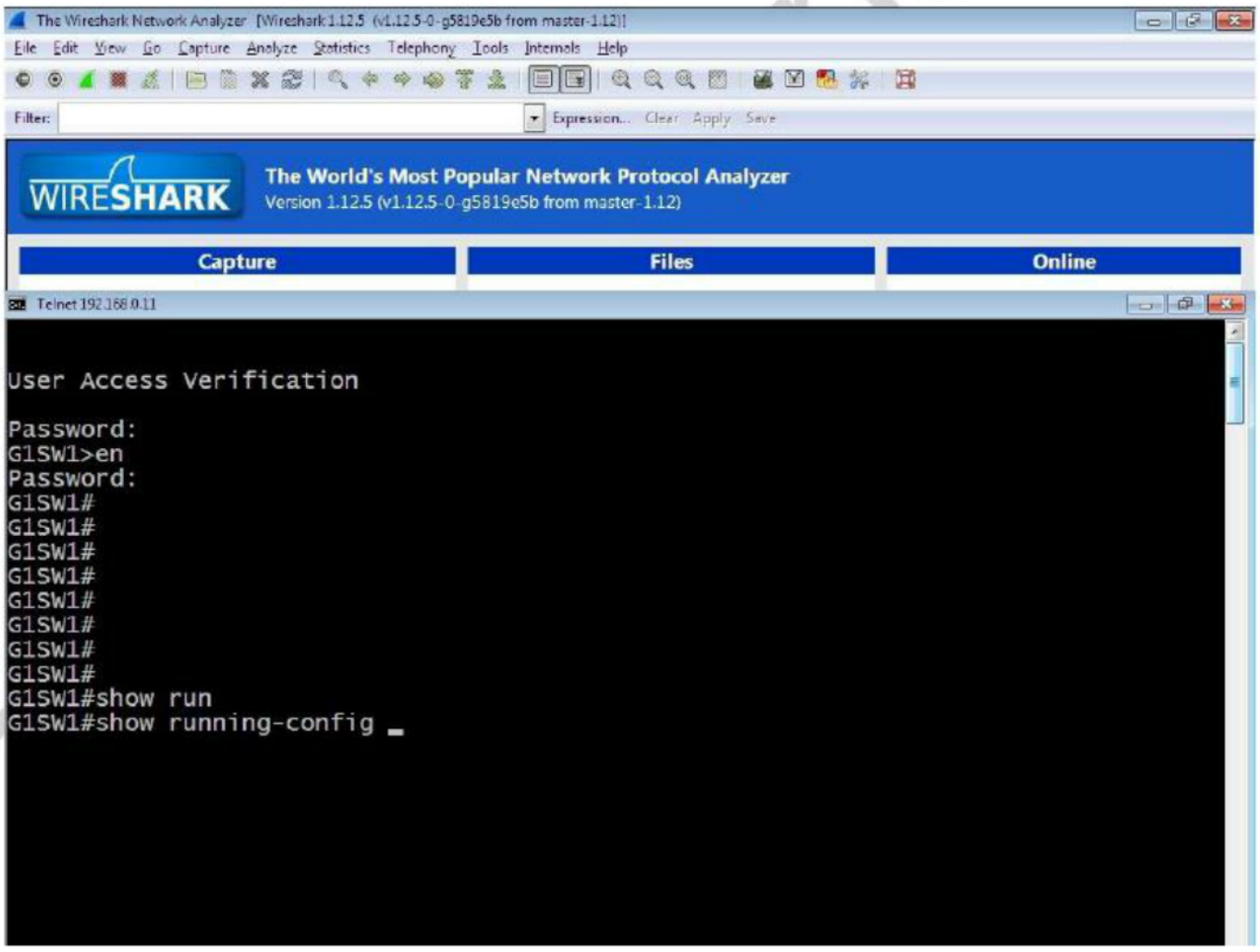
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File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
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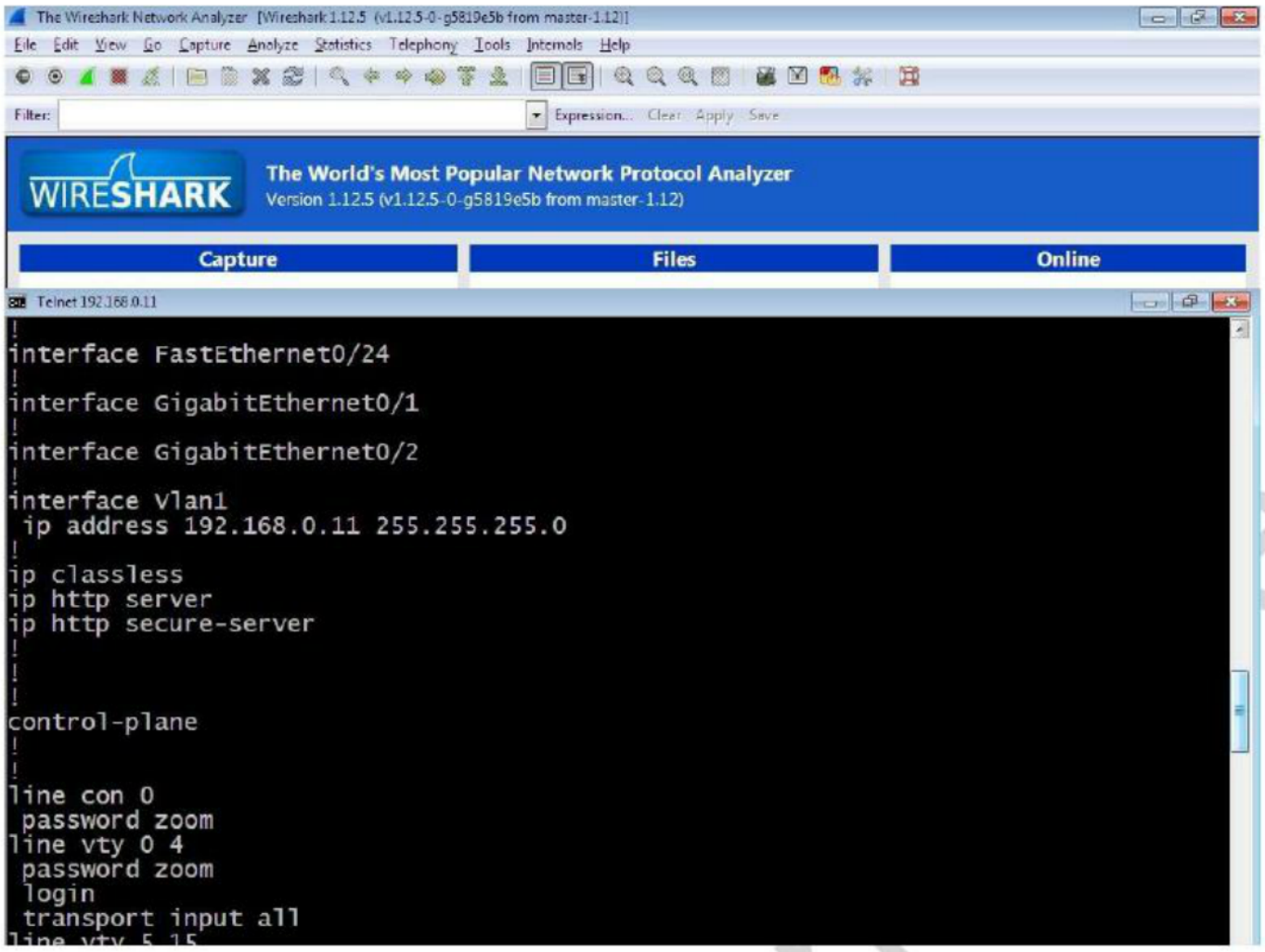
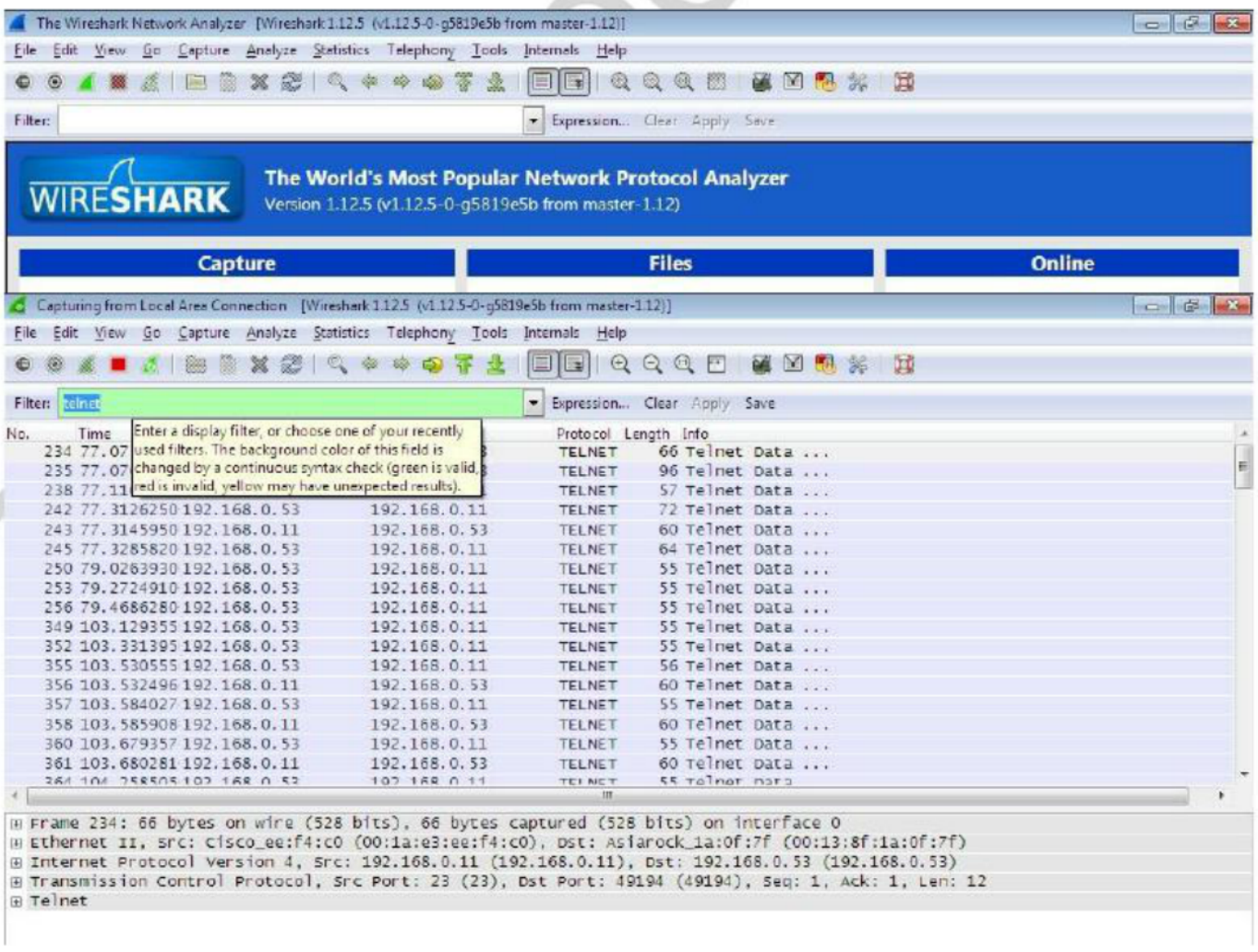
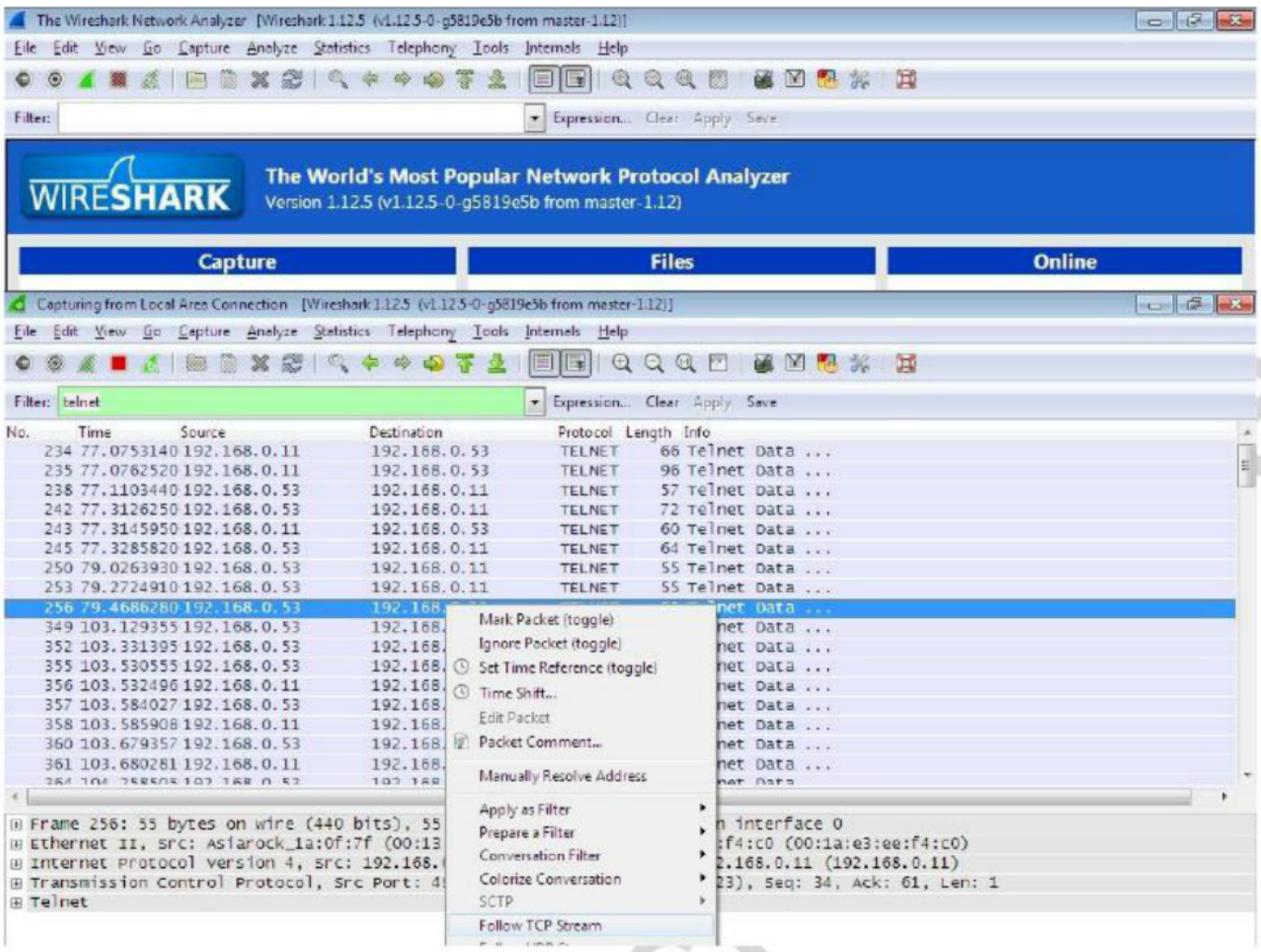
Capture
Files
Online
Telnet 192.168.0.11
User Access Verification
Password:
G1SW1>en
Password:
G1SW1#
G1SW1#
G1SW1#
G1SW1#
G1SW1#
G1SW1#
G1SW1#
G1SW1#
G1SW1#show run
G1SW1#show running-config

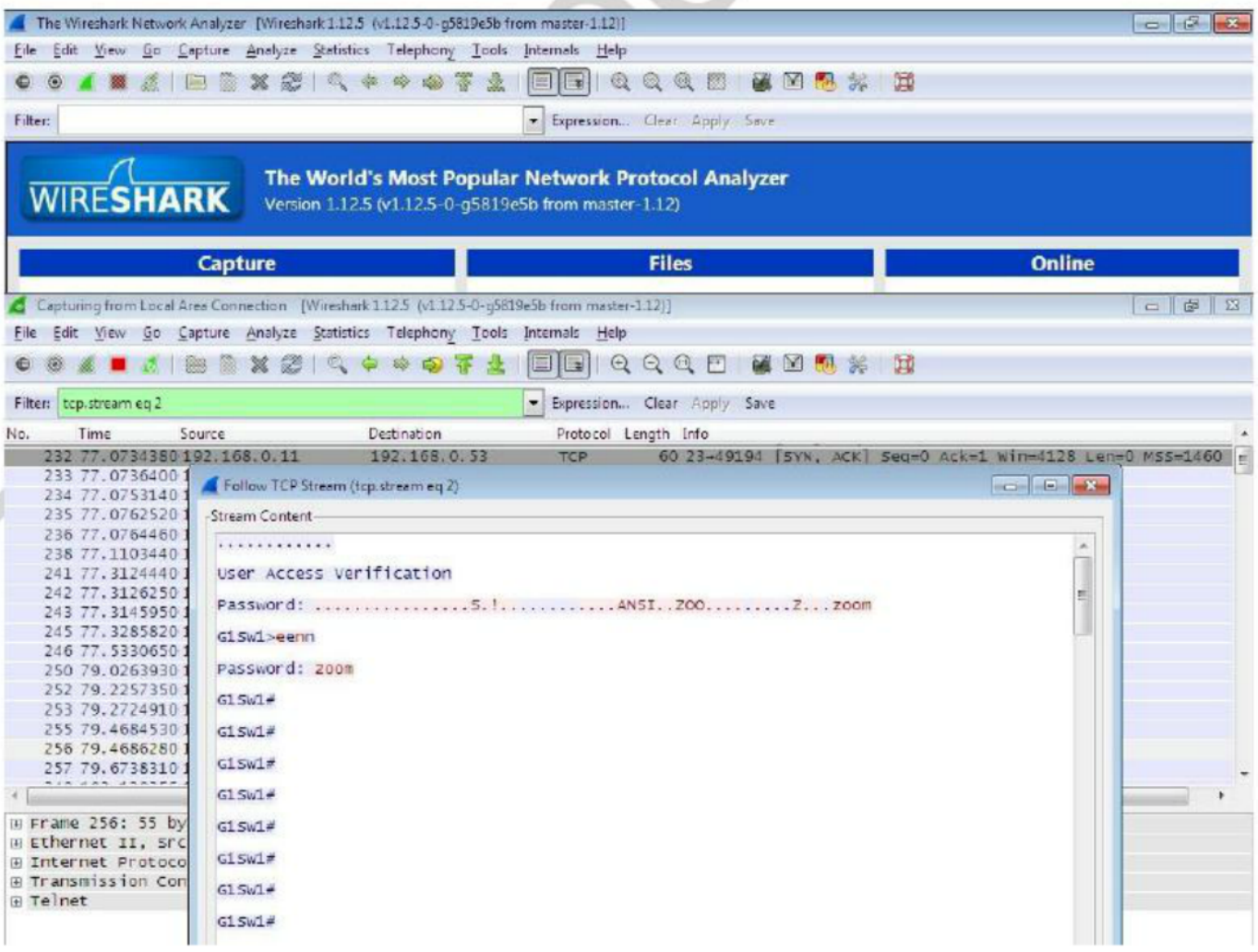


4) Now open Wireshark and type telnet in **Filter** to separate Telnet traffic.



5) Select any Telnet Packet and Click on Follow TCP stream to know the information of telnet traffic.





LAB: Monitoring Network Devices Using PRTG

OBJECTIVE:

Monitoring the performance of Network Devices using PRTG software.

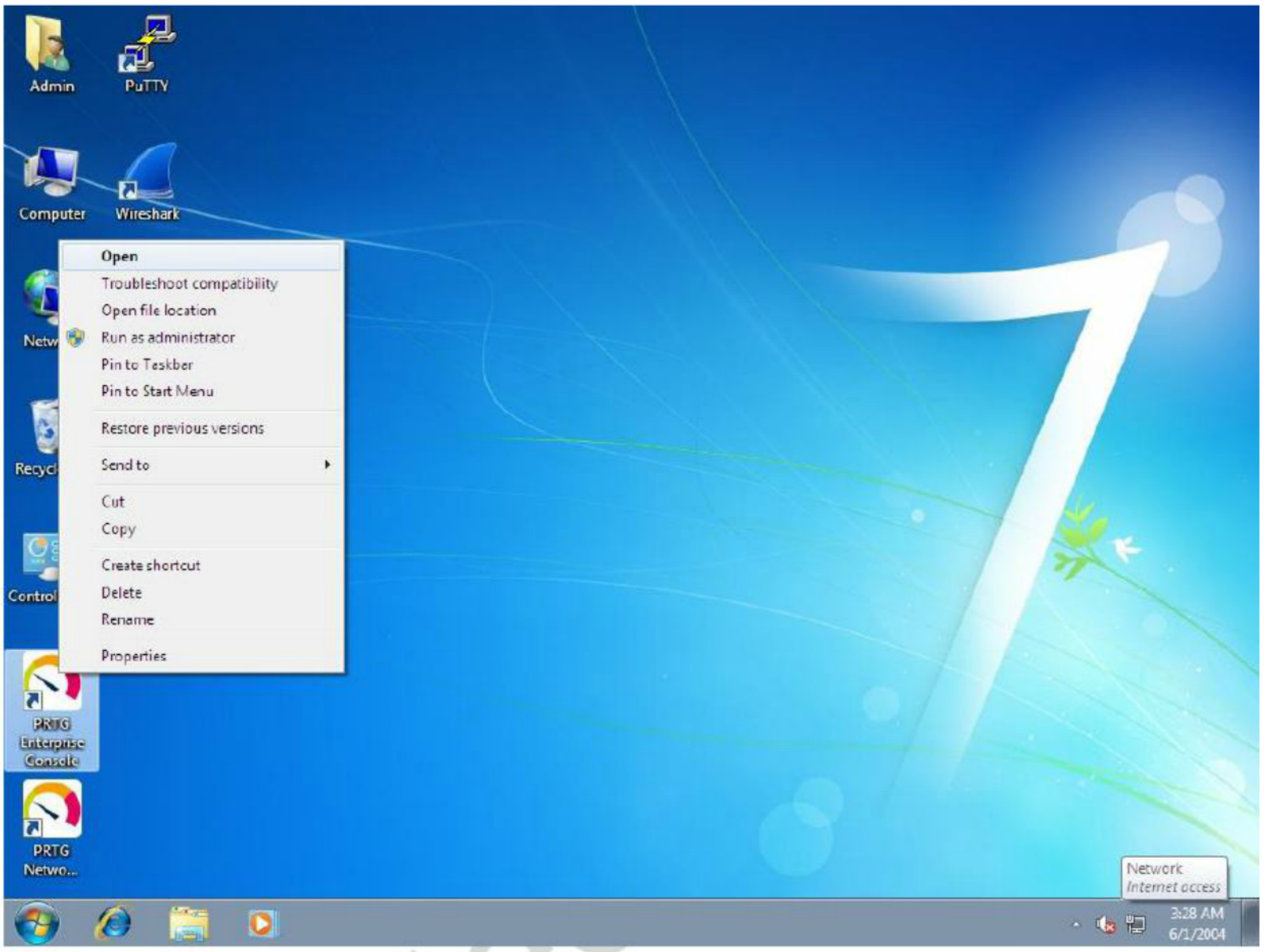
TOPOLOGY:

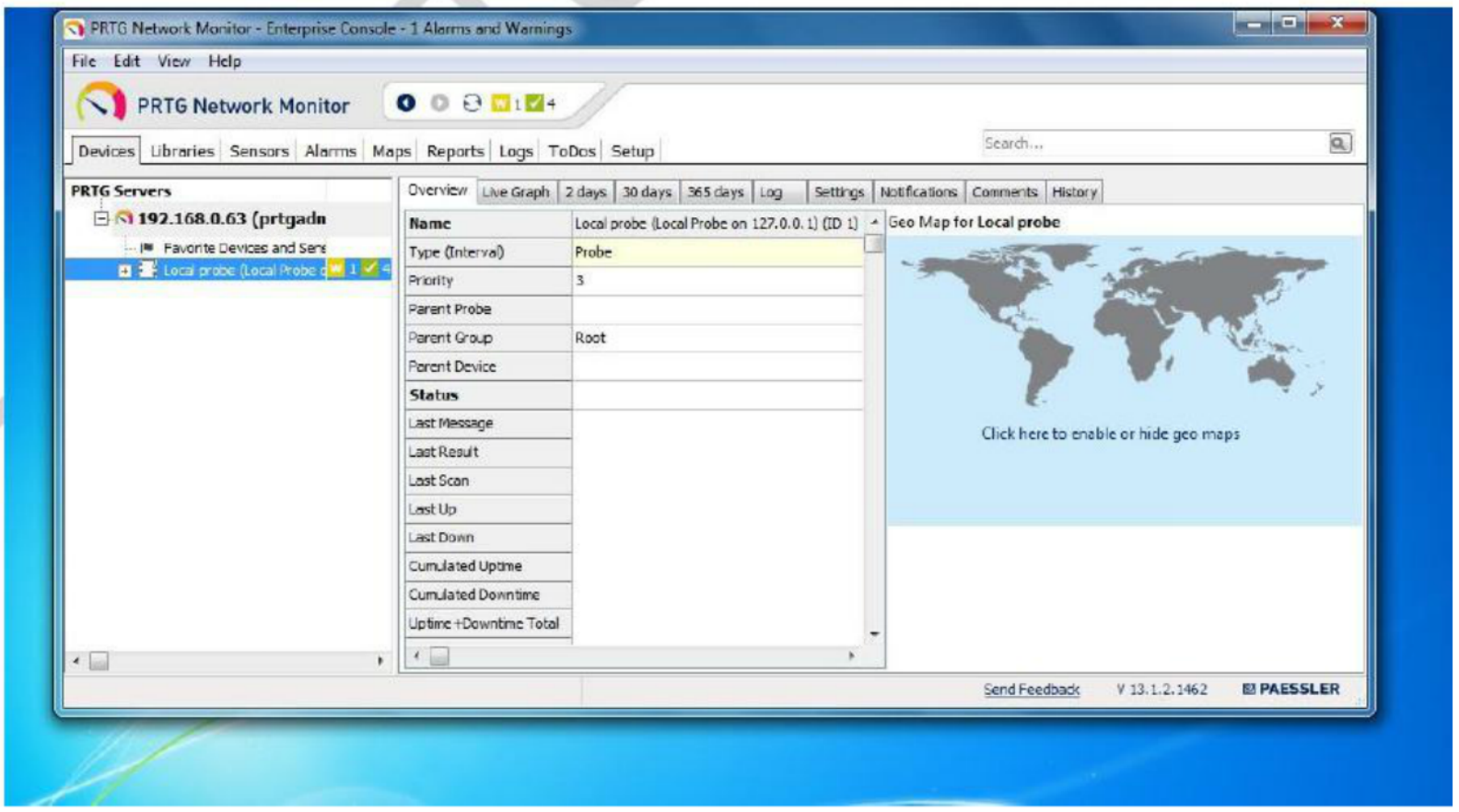
TASK:

1) Monitoring the performance of Network Devices using PRTG software.

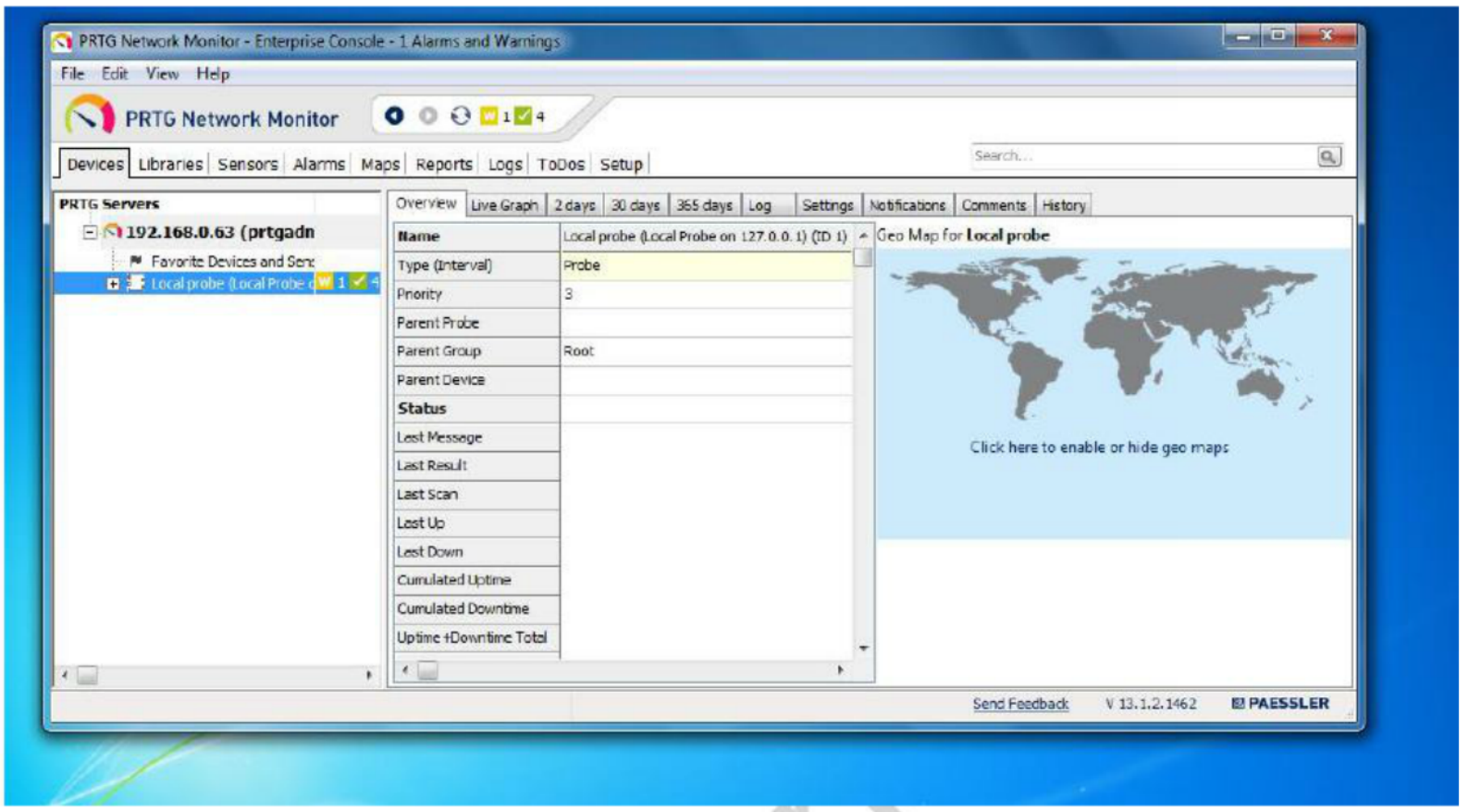
STEPS:

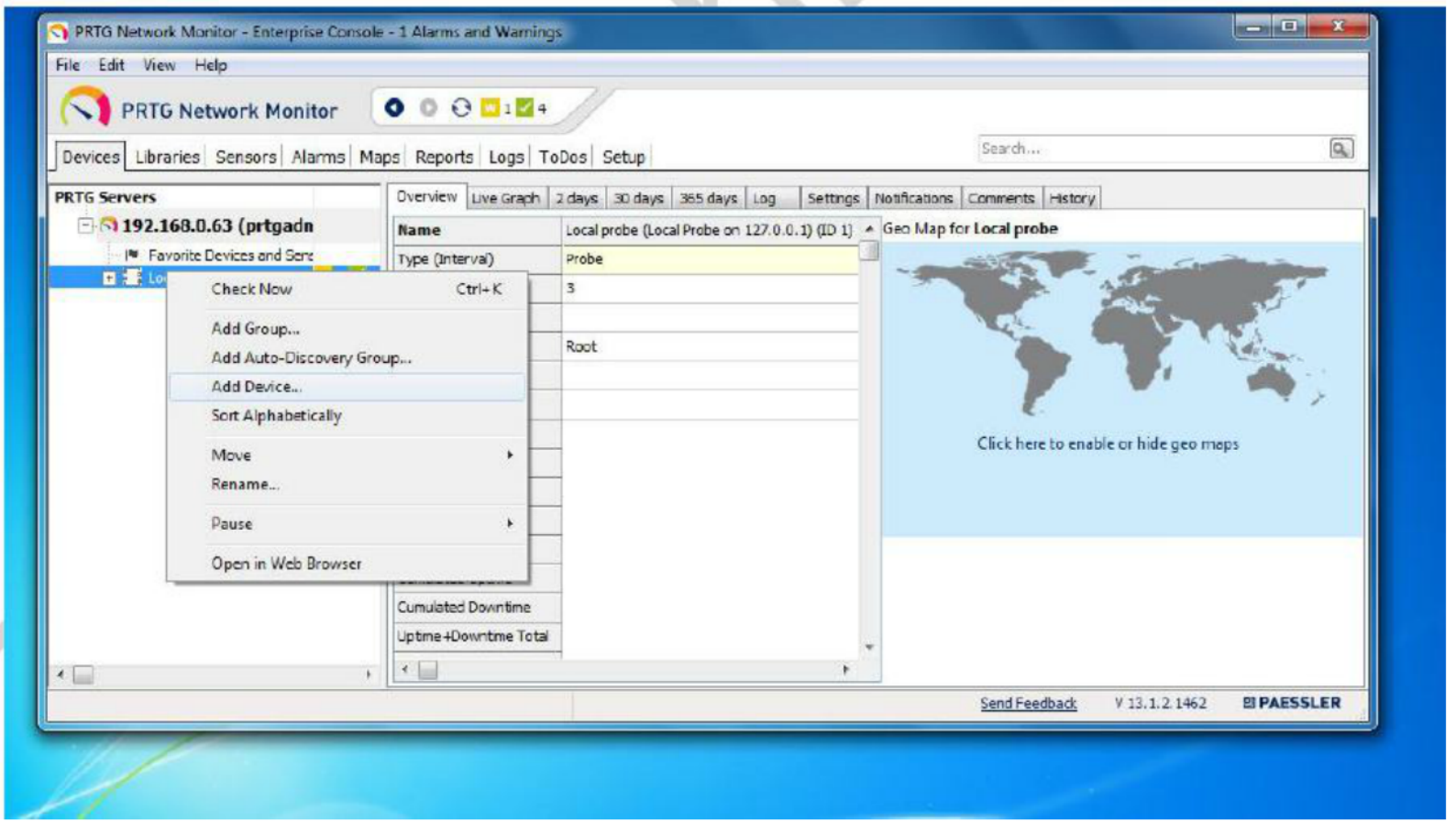
1) Open PRTG software in your snmp server pc.



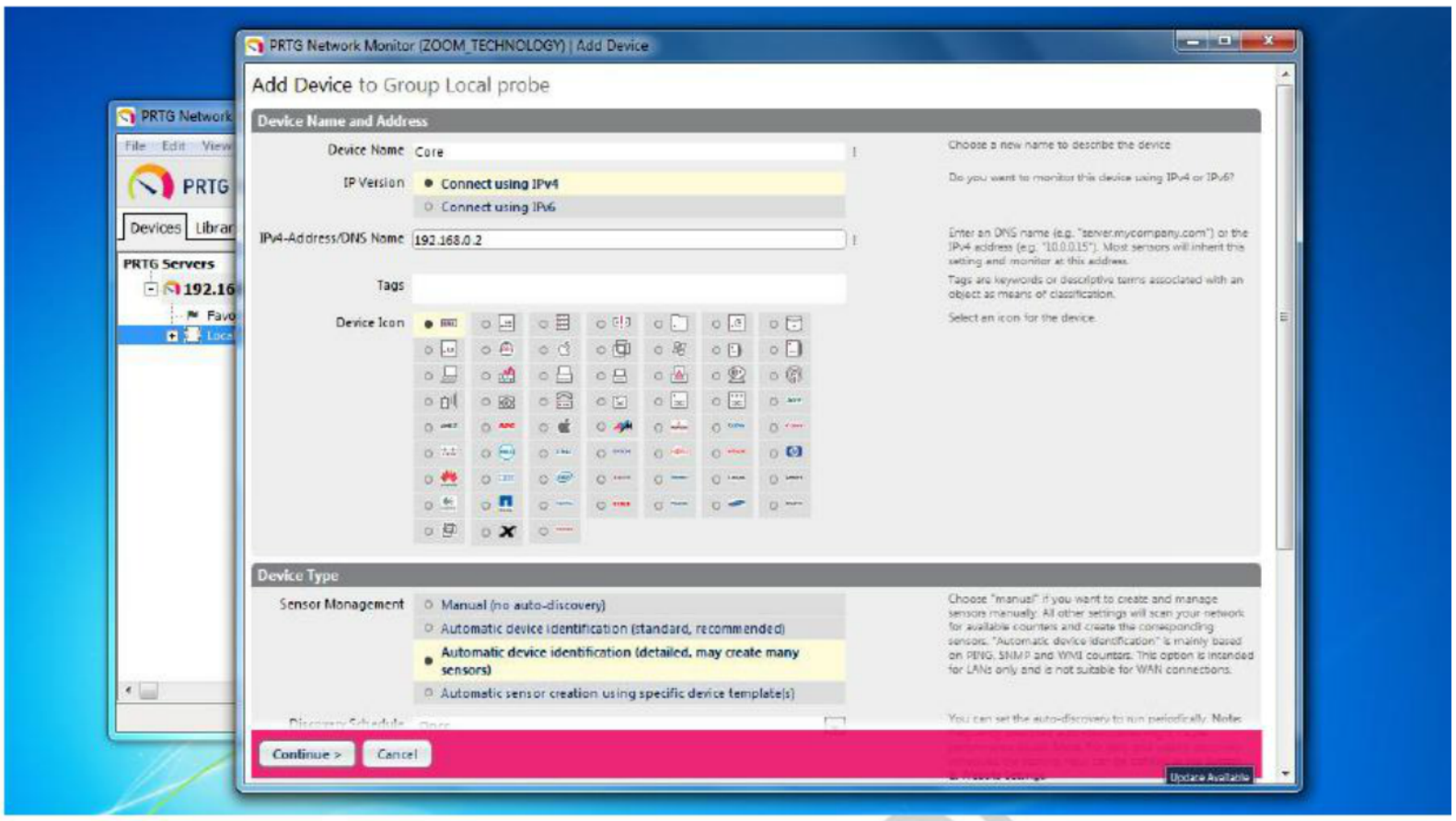


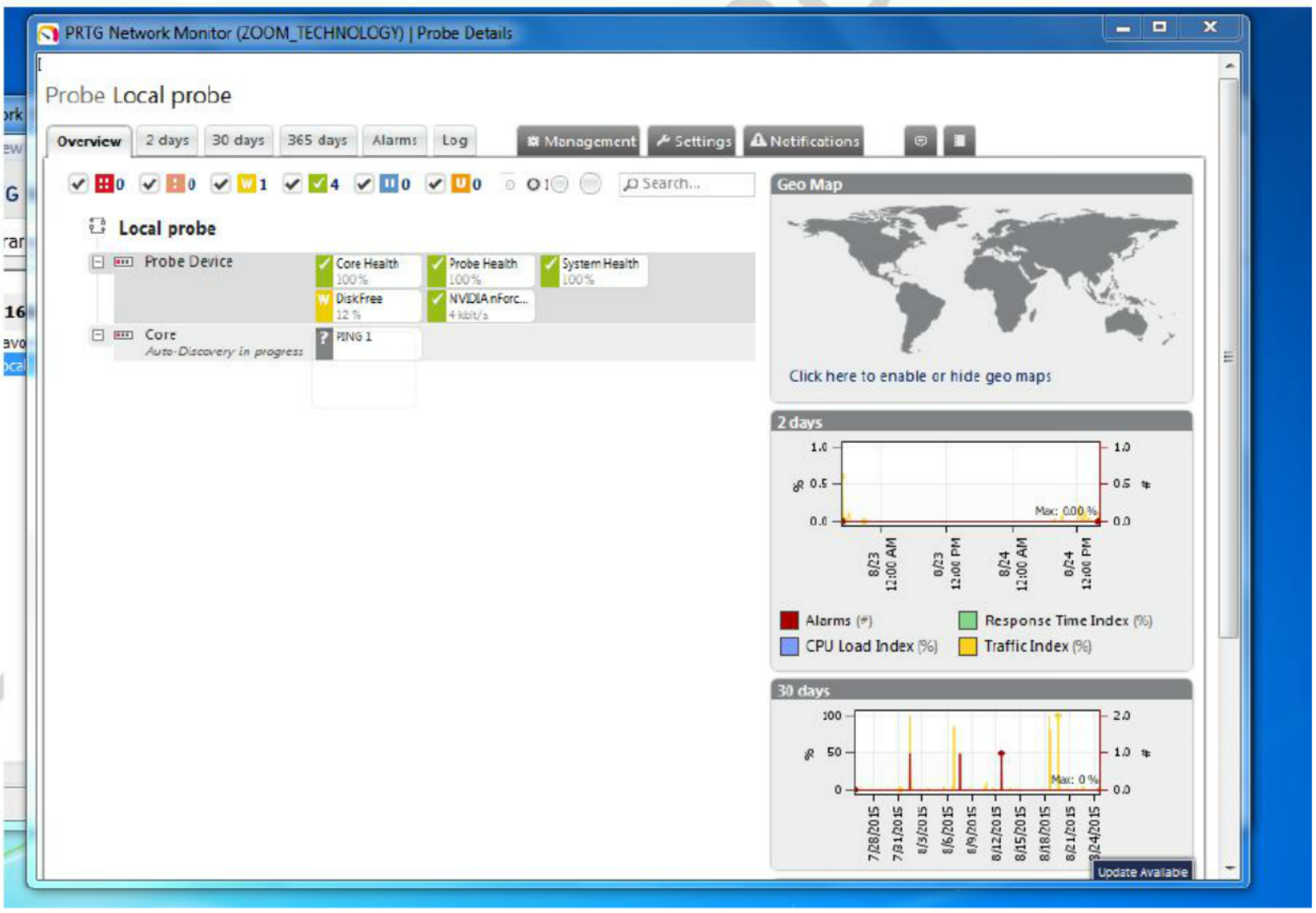
2) Right Click on Local Probe and Click on Add device to add the network device that you want to monitor.

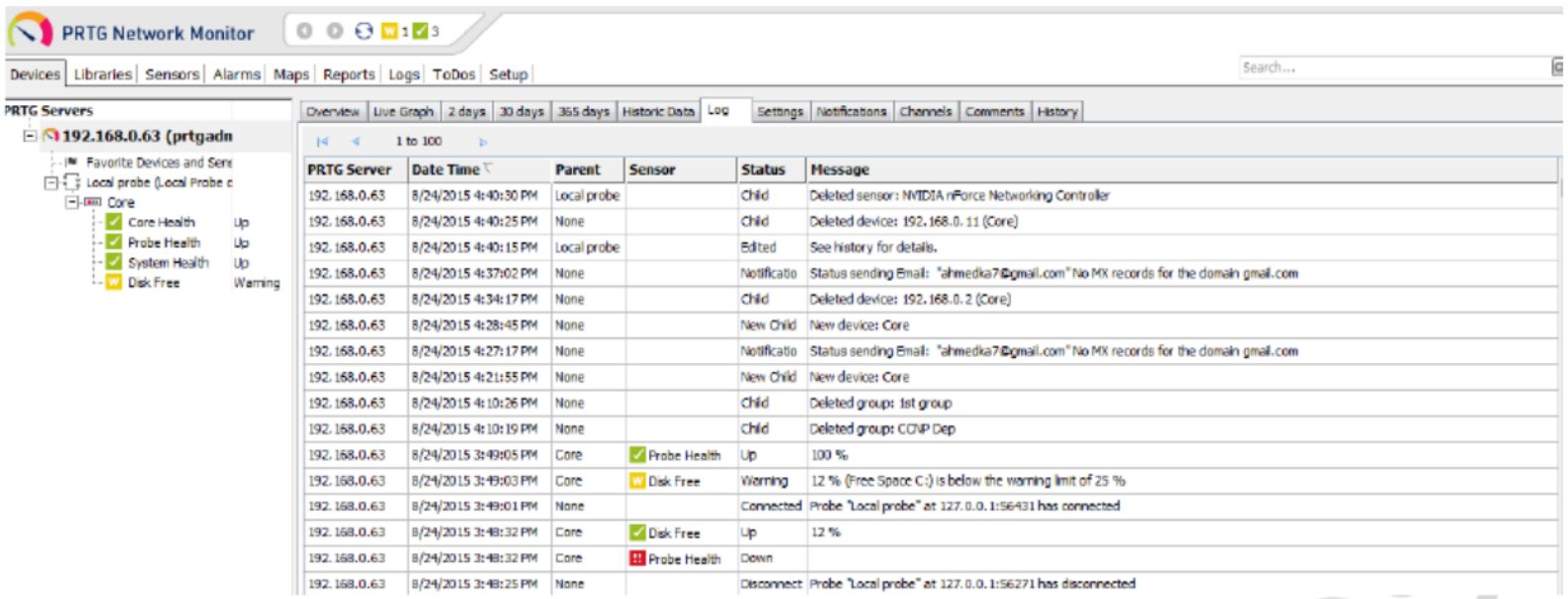




3) Give the details (Hostname, IP address) in the Add device tab and click on continue







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Batches: Morning: 7.30 or Evening: 6.00

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+ 14% Service Tax

CCNP SECURITY (Pre requisite is CCNA Security at ZOOM)

CISCO CERTIFIED NETWORK PROFESSIONAL - SECURITY
Duration: 2 Weeks | 4 Hrs Per Day (starts on 30th of every month)
Batches: Morning: 7.30 or Evening: 6.00

Fees: ₹ 9,500/-
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